AN INVESTIGATION

AS TO

The Danger of Poisoning from Lead and Arsenic in Industries Located Outside of Greater New York

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APPENDIX VIII

AN INVESTIGATION AS TO THE DANGER OF POISONING FROM LEAD AND ARSENIC IN INDUSTRIES LOCATED OUTSIDE OF GREATER NEW YORK.

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PREFACE

Hon. John Williams,
Commissioner of Labor,
Albany, N. Y.

Sir.— Upon request of the State Factory Investigation Commission an investigation was undertaken as to the danger of lead and arsenic poisoning in industries located outside of Greater New York City.

It was the aim of the present investigation to determine where the danger point in the industry, or process of manufacture was, how it could be eliminated or guarded, and the health of the worker protected; also, the relationship of the worker and the industry to the question of poisoning.

This necessitated not only an inspection and examination of the industry and various processes of manufacture, a chemical analyses of the ingredients and raw material used, and the atmospheric conditions under which the work was carried on, but also a physical examination of the workers. The latter undertaking presented difficulties, as a proper and complete physical examination requires considerable time, and in many cases the workers declined to undergo the ordeal, therefore this portion of the investigation was limited to inquiries, a superficial physical examination, and in some cases estimation of haemoglobin and urine analysis.

Together with Factory Inspector John H. Vogt, to whom was entrusted the supervision of the analytical work, visits were made to factories wherein lead and arsenic or their compounds were used, or reputed to be used.

In view of the short time allotted for the work, it was an impossibility to cover every industry, or even every factory of a particular industry, so as to make the investigation a complete one, but an effort was made to cover at least one or more factories in each industry and so make the investigation an intensive one.

During the course of the work it was found that in many industries modern methods and recent chemical advances had pro-

vided harmless substitutes for the more dangerous ingredients formerly used, but nevertheless, analyses of conditions were made as confirmatory records.

The lack of reliable morbidity, and even mortality statistics, makes the compilation of comparative data a difficult task, and as there is, in many instances, a vast difference between the processes of manufacture, and ingredients used in industries in this State, as compared with the same processes and industries in foreign countries, especially Great Britain, the splendid statistics gathered by the authorities abroad, are not, in all cases, applicable for comparative data.

Most important factors are personal hygiene and housing conditions, but these questions the Department was unable to take up; it was understood that the Commission would endeavor to study these problems.

It will be readily seen then that the conclusions arrived at are based upon actual facts so far as the industries are concerned, and upon observed conditions of the employees while at work or about the factories. The task of definitely placing the burden of responsibility is a difficult one, but in so far as the processes of manufacture are concerned the work was lightened. By means of physical and chemical determination, the exact cause, and the definite danger point have been determined, and definite as well as practical safeguards have been recommended.

The results of the investigation are by no means final, and it is intended to pursue further investigation as to the industries' part in the question, as well as undertake research work as to the effect upon the human economy, so that if possible, the danger of poisoning may be entirely eliminated.

That the report may be comprehensive, the general discussion has not been confined to our findings in the industries visited, but includes historical, chemical, and toxicological references. In the preparation of the report, numerous works of reference have been consulted, and as is often the case, specific mention may have been inadvertently omitted, a bibliography has therefore been appended. While not as complete as could be wished for, it is hoped that the list of references may be of aid to those engaged in further research. Through the courtesy of the Board of Directors,

there was placed at our disposal, the use of the laboratory of St. Bartholomew's Clinic. Through the kindness of President Rush Rhees, and Prof. Victor Chambers of the Rochester University, we were favored to have the use of a small research laboratory in the chemistry building of the university. The enjoyment of these privileges where analytical work could be performed to a completion was of inestimable value and aid in completing the investigation.

The investigation was not merely confined to analyses of atmospheric conditions, but analyses were made of urine, gloves, clothing, materials used in various processes of manufacture, water in which the workers had previously washed their hands, towels, dust, and floor sweepings.

LEAD POISONING.

Lead is a metal which has been known from the earliest times. It is mentioned in Job xix, 24. It was used by the Romans to make water pipes which were soldered by lead and tin, and articles made from it bearing Roman inscriptions and dates are still preserved. Pliny mentions the metal as "plumbum nigrum" and "plumbum album," and uses the word minium in its present sense of red lead. Dioscorides described a substance "molubdania," which was undoubtedly litharge. The white lead of the present day was well known to Gober in the eighth century, and lead salts, red lead and litharge (both oxides of lead) were known to the alchemists, who designated lead by the sign of Saturn ♄. Small weights of lead have been found among Viking remains dating as early as the tenth century.

The earliest discovery of lead on the American Continent is recorded fourteen years after the landing of the first English settlers in Virginia. In 1621 lead was found in the vicinity of Jamestown near Falling Creek. The increased demand for bullets by the settlers furthered the search for the metal. The French settlers also induced the Indians to hunt for the metal. for which they in turn gave them trinkets and even firearms. Some time elapsed before, by accident, it was found that the Indians living in the vicinity of Wisconsin and Iowa were busily engaged in making the metal from ore. They readily reduced the metal

from the ore by building fires over masses of the ore and digging small trenches away from the fire into which the metal could run. Thus was the beginning of the lead industry, the field of which has reached such enormous porportions.

On account of the many uses to which lead can be put in the arts, and its wide distribution over the earth, large quantities are mined in many countries in Europe, South America, Asia, and North America. Native lead is of rare occurrence, found in but few places, and then only in a laminated form. The metal is chiefly obtained from the minerals galenite, cerussite, and anglessite. Until recent years the metal was obtained from no other source than from the mineral galenite which contains approximately 86.6% lead, and 13.4% sulphur. Large deposits of galean or galenite are found in Great Britain, Germany, Spain. Norway, Turkey, France, Isle of Man, Scotland, Wales and the United States. The Colorado smelting works which came into importance in 1878, yielded in 1887, 70,000 tons of the metal. The works and mines are located at Leadville where much of the ore occurs as cerussite, a native carbonate of lead. Idaho, Utah. Missouri, New Mexico, Oklahoma, Pennsylvania, and Montana are also large producers of lead. According to "The Mineral Industry" by Charles, published in 1911, no new mines were discovered since 1910. The amount of crude lead production in the United States during 1911 amounted to 400,988 tons as compared to the production in 1910 of 392,704 tons.

In New York State, lead is found in the form of galenite at Rossie, St. Lawrence County in gneiss, the vein being three to four feet wide. It is found near Wurtsboro, Sullivan County, associated with pyrite. At Ossining-on-the-Hudson, cerrussite is found with some galenite (galena). At Otisville, Orange County, where in 1910 some prospecting was done at the Phoenix lead-zinc mine, a vein was reported at 350 feet from the tunnel mouth, the vein being drifted upon for 200 feet. At Macomb, St. Lawrence County, where galenite (galena) associated with blend and almost pure calceiteis was found, a 20-ton concentrating mill had been in operation up to 1911. Lead is found in millstone grit in a large vein at Ancram, Columbia County. These localities are at present producing no metal whatever. It is probable that

the workings cannot be successfully carried on with any profit due to the remoteness from railroads, and the low grade of the ore.

Chemistry.

Lead (Plumbum) is a bluish white, soft metal, having a bright metallic lustre when freshly cut or melted. It is readily oxidized when exposed to the air, but suffers very little loss when compared with other metals. It can be readily scratched with the human nail, easily cut with a knife, and makes a streak on paper. On account of its softness it can be readily rolled into sheets when cold, and its low melting point, 663° F.-334° C., makes it a decidedly useful metal for casting type, pipe, ornaments, etc.

There are two oxides necessary to notice.

Litharge or lead oxide, contains 92.82% of lead. It is either in crystalline scales, a fused mass, or a powder, varying in color from yellow to reddish yellow or orange, and when prepared below the melting point is called "massicot."

Minium or red lead is a compound of protoxide of lead with the dioxide. It is of a brilliant red color.

Sulphate of lead contains 73.61% lead, when produced artificially is a heavy white powder insoluble to a great extent in water. The sulphate can be readily changed into the carbonate by boiling it with solutions of the alkaline carbonates. The sulphate, fused with cyanide of potassium, yields metallic lead.

Acetate of lead, sugar of lead, is found commercially in white spongy masses composed of acicular crystals. It may also be found in flat four-sided prisms. It has a sweet metallic taste and is soluble in water.

Chloride of lead contains 74.48% of lead and is in the form of brilliant crystalline needles.

Carbonate of lead, white lead. is composed of a mixture of neutralcarbonate of lead and hydrate of lead.

As a pigment we have chromate of lead and a bichromate of lead.

Before entering upon the analytical work where it was known that very small amounts of lead were to be dealt with, it was necessary to consult the latest text books for methods to conduct quantitative and qualitative analyses. After considerable experi-

menting, the most reliable, accurate and speedy method adaptable to atmospheric analysis proved to be that of Schwartz modified by Diehl, and still further modified by Mr. Vogt.

In all operations for atmospheric analysis, where, owing to the nature of the work lead was supposed to exist, large volumes of air, not less than 1,000 litres, were aspirated through a battery of specially designed wash bottles containing doubly distilled water, by means of an air pump. The exact capacity of the pump having been definitely determined, the exact amount of air passing through the solution was known. After securing a sample, the solution in the bottle was decanted, the suspended material in the solution dissolved in nitro-hydrochloric acid, the solution evaporated to a small bulk, to which is added sulphuric acid, and allowed to stand for at least twenty-four hours. The solution is again evaporated until fumes of sulphuric acid appear, distilled water is then added, and the solution run through an asbestos filter devised by Mr. Vogt. The residue after thorough washing is transferred to a flask and strong ammonium acetate added, whereby the sulphate of lead is dissolved. The residue is again filtered, the filter being treated with hydrochloric acid, water, and finally acetate of ammonium and hot water. To the filtrate placed in the flask is added the solution of potassium bichromate in excess, whereby the lead is precipitated in the form of chromate. The excess of potassium bichromate is estimated by $\frac{N}{10000}$ solution of sodic thiosulphate. The two standard solutions were in every case standardized before every series of tests, in order to obtain exact results.

In some cases the lead was determined colorimetrically by the addition of sodic sulphate and dissolving the lead sulphate in ammonium acetate as before mentioned, the brownish color formed indicates the presence of lead, corresponding to the exact bulk of the solution to be tested. By means of this method accurate results were obtained.

In the examination of gloves, aprons, clothing, floor sweepings and water from the washings of the hands of men and women, the method employed was as follows:

First, all organic matter was destroyed by using one of the well known methods according to Prescott, then dissolving the

residue, filter and convert into the form of a lead sulphate and estimate, either gravimetrically or volumetrically by means of the methods previously mentioned and modified by Schwartz.

In the analyses of urine for the presence of lead, large quantities of urine are necessary, as well as plenty of time, so analyses along this line was limited. The method employed was as follows:

A litre of urine was evaporated to dryness on a water bath, the residue moistened with nitric acid, and when effervescence has ceased, the bright colored residue was transferred to a platinum crucible, heated and carefully ignited. The crucible and contents together with distilled water were placed in a beaker, hydrochloric acid added, filtered hot and washed with hot water. To the filtrate was added ammonium hydrate and ammonium sulphide for the purpose of precipitating the lead with phosphates and iron. The filtrate was washed by decantation, an excess of hydrochloric acid added to dissolve the sulphide of iron and the phosphates. After standing some hours, the mass was filtered, washed with boiling water, and to the residue of the filter nitric acid added; after washing into a beaker, the material was evaporated to dryness, dissolved in a very little acetic acid and a very small quantity of sulphuric acid added, sufficient, however, to cause complete precipitation. A cloudy precipitate indicated lead, which was placed in small cylinders about six inches long which was compared with a similar cylinder containing an equal amount of a trial sample of sulphate of lead. By comparison of the colors it was easy to calculate the amount of lead present, where the color did not compare, new trial samples were made until the colors matched.

Where doubt existed as to the presence of lead in the atmosphere, the microscope was used upon samples obtained in places where colors known to be of lead origin were used.

Toxicology.

Lead, more than any other substance has engaged the attention of writers and investigators for many years, and the literature relating to the subject is voluminous. In fact, it would seem that the last word had been written and published upon lead poisoning, especially in connection with industrial life, and further

investigation would merely emphasize facts already established as to the danger and ravages incidental to its use.

The fact has been fully established that lead and its compounds are poisonous, the toxicity being in direct proportion to the solubility in the human economy.

Notwithstanding the researches and investigations made as to lead poisoning, there is still considerable discussion as to the means of absorption of lead into the system.

All authorities agree that it is absorbed through the alimentary tract, and this has been a definitely accepted fact for years.

It is asserted that there is absorption through the respiratory tract, and Dr. Goadby seems to have proved the accuracy of this theory. This would seem to confirm the findings of Tanquerel des Planches in 1840.

Considerable doubt exits as to whether lead is absorbed through the skin. Many authorities claim it is impossible if the skin is unbroken and healthy. M. Manouvriez and Prof. Proust assert that it is absorbed through the skin, and this view seems to be taken by a number of German authorities.

It was impossible to go into these matters owing to lack of time and proper facilities, so that no conclusions as to the last two theories can be ventured. As a result of close observations I am of the opinion that no matter whether the lead is inhaled, or deposited on the skin, there is always the liability of some of it entering the alimentary tract.

The susceptibility of individuals to lead poisoning varies considerably, though it is well known that children and females are affected more quickly than male adults.

In many cases symptoms of poisoning have occurred within a very short period after exposure to the poison. It is reported that fifteen and twenty years have elapsed before any trouble was experienced. In my own experience cases have been seen where symptoms developed over ten years after the individual had been entirely away from the influence of lead in any form.

It is fully conceded that the acute form of lead poisoning is rarely seen in workers engaged in the industries; it is deemed advisable, however, to describe the symptoms of the various forms.

Acute lead poisoning. The symptoms of this form usually occur after large quantities of a soluble salt, such as the acetate,

is taken into the alimentary tract. There is a sweet metallic taste in the mouth, and pain in the epigastrum, followed by colic. At times there is vomiting of a whitish liquid or curds. With the increased gastro-intestinal irritation, diarrhoea occurs, or the astringent action of the lead may result in constipation. The feces are black in color, due to the action of the sulphuretted hydrogen in the intestines converting the lead salts into the form of a sulphide. There is excessive thirst. Cramps in the calves of the legs are complained of, and muscular twitching may be noticed. In fatal cases there may be spasms, coma, and collapse.

Owing to the insidious nature of the poison, and the absorption of small quantities over a long period, the form of industrial lead poisoning seen is usually chronic.

Chronic lead poisoning. The symptoms of this form are attributable to disturbances of nutrition, and of the gastro-intestinal and nervous systems. No poisoning presents such a variety of symptoms which similate those of many diseases, or even other poisoning.

Disturbances of nutrition. The primary symptom is a marked anaemia, resembling to great extent that of pernicious anaemia, or anaemia of renal disease. The percentage of haemoglobin and the number of red blood cells are reduced, but there is no change in the absolute number of leucocytes. In my opinion, the least sign of anaemia in a worker, confirmed by blood examination, should be sufficient cause to remove him from the influence of lead and begin treatment for poisoning.

The presence of a bluish line of the gums has always been considered as diagnostic of lead poisoning, even where all other signs fail. It is pointed out by Prof. Osler that it may be confounded with a line on, not in, the gums, which is readily removable by cleaning the teeth. In my experience, many cases with marked symptoms of poisoning have not shown the least sign on the gums, and in a large number of workers who were not exposed to lead in any form, a blue condition of the gums was found, due to an irritation and retraction of the gums resulting from tartar deposits on the teeth.

Gastro-intestinal symptoms. Among the first symptoms of lead poisoning is the "colic," known under various names as Colica

saturnina, Colica pictonum, painters' colic, Devonshire colic. The pain is of an intense character, generally in the region of the umbilicus, coming on in paroxysms of long or short durations, but relieved by pressure upon the abdomen. Poisoning exhibits itself in the form of dyspepsia or indigestion and severe constipation, and there may be merely attacks of nausea and vomiting.

Nervous symptoms. These are usually in the form of a paralysis termed "lead palsy," or affections of the brain termed "lead encephalopathy." So much has been published relating to these forms that but brief mention will be made of them.

The type of paralysis best known is that of the extensor muscles of the fingers and wrists, producing the well described "wrist drop." Preceding this condition there is usually an arthralgia with pains in the joints and muscles. The knees are usually first affected, next the elbow and shoulder joints. At times the muscles of the chest and neck are affected.

Encephalopathy is not at all common and is due to the action of lead upon the nerve centres. The symptoms include convulsions, delirium, coma, asphasia, hysteria and insanity.

The diagnosis of lead poisoning should not be difficult, when there is a history of exposure to lead, but many patients are treated for rheumatism, stomach trouble, nervous troubles, liver trouble, syphilitic paralysis, and even operated upon for appendicitis, when the case is one of lead poisoning, the cause of which has been entirely overlooked.

Where there is danger of mixed poisoning, such as arsenic, there may be slight difficulty of diagnosis. This is discussed in the report on arsenic poisoning.

Lead is stored up in the organs of the body for an indefinite length of time, and, when eliminated, it is in very small amounts through the urine, hence there are a large number of diseases remotely caused by the absorption of the lead.

Attention is called to the fact that analysts as a rule seek for lead in all cases of suspected adulteration of food or drink, and that cases may be traced to the use of lead pipe for drinking water or beverages. Thus care must be taken not to indiscriminately place the burden upon the industries.

Dr. Layet prepared a table of professions where the worker was exposed to lead poisoning. There are 111 of these, as follows:

Refiners of lead.
Lead fitters.
Cloth singers.
Cloth dressers.
Artistic paints.
Laundresses.
Bakers burning old wood in oven.
Bronzers.
Brush makers.
Color grinders.
Workers in hair.
Manufacture of cardboard.
Hatters.
Beltmakers.
Armorers.
Tinkers.
Chauffeurs and mechanicians.
Colorers of official paper bands.
Makers of cigarette paper and wrappers.
Iron wire workers.
Shoemakers.
Dressmakers.
Decorators of porcelain.
Lace makers.
Stamping of embroidery patterns.
Solderers of cans.
Gilders on wood.
Cabinet makers.
Enamelers of electric porcelain.
Bookkeepers using sealing wax.
Assaying precious metals.
Tinning or silvering metal.
Use of color in matches.
Manufacture of coach tops.
Coverings of wagons and coach hoods.
Manufacture of leather varnish.
Manufacture of vitrified bottles.
Manufacture of gloves.
Manufacture of pewter and lead toys.
Manufacture of white rubber.
Waxed linen, and napped cloth
Varnished furniture.
Chemical furnaces.
Making of bottle caps.
Glazed cardboard and paper.
Manufacture of chromate of lead.
Manufacture of white lead.
Making of colored crayons.
Making of steel augers and bits.
Making of watered paper.
Making of enamelled ware.
Manufacture of pins.
Making of metallic cloth.
Oxychlorate of lead.
Toy makers.
Making of musical instruments.
Making of cartridges.
Making of minium and massicot.
Making of litharge.
Making of acetate of lead.
Making of shot.
Making of putty.
Making of tinted satin paper.

Making of organ pipes.
Making of material for pasting on windows to decorate.
Making of crockery.
Making of artificial flowers.
Plumbers and tinners.
Lead workers and founders.
Casters and polishers of letters.
Casters of brass, bronze, etc.
Manufacture of paste jewels.
Printers, compositors.
Journalists, proof readers.
Lithographers.
Lead rollers.
Lapidaries.
Fur dressers.
Carpenters, and handlers of old wood.
Dealers and mixers of colors.
Jewellers.
Workers in copper.
Lead miners.
Workers in glazes.
Making metallic capsules.
Fasteners of bottles with wire.
Making of cut glass.
Makers of perfumes.
Pharmacists.
Painters.
Coach painters, scrapers and glazers.
Decorators and painters.
Making plumbers' supplies.
Polishing of cameos.
Pewterers of tin.
Enamellers of porcelain.
Passamenterie.
Cloth cutters.
File cutters.
Glass cutters.
Locksmiths.
Calico printers.
Telegraphists.
Weavers.
Making of tile.
Wire drawers.
Handling of public documents.
Making of glass.
Glaziers.

This is an interesting list, but when it is considered how widespread is the use of lead and its compounds it might seem that a list prepared of the few professions where there is no danger would speedily attract attention.

Statistics collected relating to lead poisoning are voluminous, but this fact stands prominent in all, namely, the danger appears greatest among painters, white lead makers, and workers in potteries.

The result of the first year of compulsory reporting of industrial poisoning in this State would indicate that the greatest number of cases of lead poisoning occurred among painters, and next among workers at storage batteries, and only a few cases among white lead workers.

A number of lay investigators report finding large numbers of poisoning among white lead workers in this State, but as no white lead works came within the scope of this investigation the statistics cannot be verified. From my own experience in visits to white lead works, there are probably many true cases not reported or recognized, and it is possible that many cases are wrongly diagnosed as leaded.

Industries.

To properly investigate every industry wherein there was reputed to be danger from lead poisoning would prove a task of gigantic proportions covering a long space of time, and to make a complete study of the subject in but a few of the industries where most danger exists is a task of herculean aspect.

An endeavor was made to investigate as many industries as possible, and especially the factories having had cases occur which were reported to the Department. A table is appended showing the results of our visits.

During the course of our visits experiments were tried to discover some means for ascertaining the presence of lead in the system, before the manifestation of any symptoms, but all proved unsuccessful. One method proved of value in another direction. A French authority had reported that the use of an alkaline solution of sodium sulphide applied to the skin would aid in detecting the presence of lead in the system when there were no other signs. A 10% alkaline solution of sodium sulphide was made up and tried, but with no results, even on cases showing marked symptoms, but it did serve to show the presence of lead on the skin when the worker failed to wash properly. Some one hundred workers were tested after they had washed their hands thoroughly with soap and water after the day's work, or at noon time. Upon applying the sulphide solution, 65% showed the presence of lead (through the formation of a gray spot where lead sulphide was formed upon combination with the alkaline sodium sulphide), showing the absolute necessity of some means guaranteeing cleanliness. In several plants, where a popular brand of washing powder was used, fifteen workers who used the powder were examined and no lead found. It is probable that the ingredients of the powder converted such lead as was not removed into an in-

soluble sulphate, proving this type of cleanser to be an excellent one, and a means for prophylaxis.

In the description of the various industries visited, an attempt has been made to group them under special headings or classifications. In many instances there have been carried on in one plant a number of processes which might be grouped under different headings. In such cases the process has been referred to under the heading and the plant described as a whole.

Mining:

The danger in mining arises from the dust created, as well as from the workers soiling their hands and body. The danger from dust during the process of drilling can be eliminated, and in the Leadville, United States, mines drills are fitted with an arrangement to exhaust the dust generated.

Two mines at Maccomb were visited, but they had not been worked in many months. At the larger mine the former foreman was interviewed, and though he claimed never to have had any symptoms of lead poisoning, his appearance was very much like that of a lead anaemia. He stated the shaft was 75 feet deep with drifts of about 150 feet. Water filled the mine almost to the top of the shaft. Information was secured that several of the miners had suffered from severe colic, caused, it was said, by drinking water in the mine.

Industries Where Lead and its Alloys are Used.

Smelting:

One small plant was visited where lead was extracted from junk. It was little more than a shed, and no work was in progress at time of visit. Pots were covered and provided with a hood to carry off the fumes. Soap, towels and goggles were furnished. It was admitted that meals were eaten near the pots. One man was seen, he was anaemic, and, in my opinion, suffering from effects of lead.

Lead Pipe:

In making lead pipe, the lead is melted in pots, then run into a chamber where it is forced out through a mould of the size desired, or, as in the case of plumbers' supplies, of a certain shape,

and then sawed off. In the manufacture of cables for electrical use, the core is passed through the hydraulic chamber and covered with the lead in exactly the same way as lead pipe is made. The cable is then coiled on a reel.

The danger in the process is from the fumes of the metal pot, and the escape into the air of oxides resulting from the cooling of the metal. There is also danger to the worker from getting the metal or oxides upon the skin, as in handling the product with unprotected hands.

Solder:

Solder consists of lead and tin with sometimes an addition of copper or zinc. The amount of lead in the alloy is at times 50% or more, according to the softness of solder required.

Fourteen plants were visited where lead pipe, solder, or lead cables were made.

Lead works. This is a two-story building, the first floor of which is devoted to making lead pipe and solder. The floor is 170 feet by 60 feet, with 12 feet height of ceiling. Doors and windows are located on one side and at front and rear end. Along one side of the building, and in a depression of the floor, are situated a number of solder pots and machines. In a dark corner at one end, about five feet from the floor, is another solder machine, and on the light side of the building in front are two pipe machines, the lead pots of which are hooded. Five of the solder pots are hooded, but one tin and solder pots has no hood.

In the making of plumbers' supplies (traps, etc.), after sawing off from the machine the edges are trimmed by filing, and then a small brass cap is soldered in the seal of the trap. There are a number of ways then in which the workers are liable to be affected by the lead used. Fifteen men are employed, none under eighteen, and mostly all adults.

While it is a difficult matter to keep a place of this character clean, there was room for improvement, as pig lead and sheet lead, together with dross and oxides, were scattered about. It was claimed the place was cleaned twice or three times a week, but twice a day is not any too often. During the work the men are furnished with gloves, which I noticed they wore. There was one sink, but no hot water. Meals were eaten in the shop.

In this place a clean pair of gloves was furnished one worker and analyzed after one day's use, with the following result, lead present, .0061 grams. A pair of gloves said to have been used for three days was analyzed and showed 1.37 grams lead. Air samples taken at machines while in operation showed no lead present.

A number of the workers are anaemic and complain of having had stomach trouble, one was undoubtedly a true case, having been employed two years, and having suffered from colic. One worker had been sixteen years with the firm, was robust, showed no symptoms, but had a distinct blue line along the edges of the gum, and in my opinion was leaded.

Lead Company. This plant formerly made white lead, but now simply acts as a storage, and on the first floor fronting the street has a lead pipe machine. The room is 80′ x 50′ and 12′ in height. The lead pots are provided with a hood, and blades are fitted to main shaft to aid in circulating air. Gloves are furnished to the workers; hot and cold water and soap are provided. Meals are eaten in room where pipe is made. General conditions in this place are good, and an analysis of the air failed to show any lead present. The men have been employed a number of years, are cleanly, and no cases of plumbism were found.

Metal Company. This plant is devoted to the manufacture of solder and babbitt metal. The building is a comparatively new one-story brick structure with a concrete floor. Its dimensions are 50′ x 60′ and 40′ to the peak of the roof. There are four metal pots situated under a very efficient hood. The metal is dipped from the pots and poured into moulds, during the operation the workers wear gloves furnished by the firm. The place is kept clean, and hot and cold water is provided. No meals are eaten in the lead room. There are three employees who have been with the firm some twenty years, and showed no symptoms of plumbism. Analysis of air showed no lead present.

Plumbers' Supply Co. This firm manufactures lead pipe and solder. A portion of the building is devoted to this work. First floor, 50′ x 25′, height, 12′: the place is a very open one. There are two pipe machines, the lead pots of which are hooded. One case was found. He had been working seven years at lead, and

for five years has been suffering from muscular and nervous troubles. He was anaemic and had the blue line on gums. He took no precautions, such as wearing gloves, and was not very cleanly as to person.

The second floor is of the same dimensions as the first and is devoted to the making of solder. There is one lead pot hooded, and solder is ladled out into moulds. There is one worker who has been seven years a solder maker, and for four years has been suffering from lead. He takes no precautions, is not clean, and drinks. Has a blue line in gum.

The firm furnishes no gloves to the workers, and there is hot water only when the boiler used for heating the plant is in operation. General conditions in the plant are fair.

A number of can companies were visited where solder was made, and are described under soldering.

Three plants were visited where lead cable was made and are described further on in the report.

Two foundries made their own babbitt metal.

Two storage battery plants made lead castings and are described under a special heading.

Company. This firm makes carborundum wheels and during the finishing, lead is used to bush (fasten) in the iron center of the wheel which fits on the spindle of the shaft. There are eight men engaged at this work, and there are four small pots in the center of the room. The shop is 60′ x 200′ x 17′ high. An exhaust system is installed to remove dust from the dressing wheels, but at time of visit was not working effectively and considerable irritating dust was present in the air. There was no wash room for this portion of the works, but goggles and respirators are furnished, but seldom worn. No lead was found in samples taken, and no cases were found. There is room for needed improvement. Gloves should be supplied the lead workers, and the pots should be hooded. Proper washing facilities should be installed.

Several locomotive works were visited, and it was stated lead was used for filling in the counterweights on the driving wheels, and for babbitt on the bearings, the work being done practically

in the open. No work was being done during the time of our visit, and no cases of plumbism could be found.

Two newspapers were visited where linotypes were used, also stereotyping done, and are described further on.

Lead as a Tool Hardener:

With the forging of various steel objects, lead is used as a hardening agent. The steel is heated to a red color, then plunged into a pot of lead heated to about 1500° F. and then forged. During the process, the worker is exposed to the danger of the lead fumes, and also from the dust containing the oxide which results from cooling and during forging.

Arms Co., No. 1. This firm manufactures fire-arms (guns), and uses lead for tempering the safety springs of the guns. The lead is placed in small pans on an open fire and springs dipped in them. In the shop is a vacuum system of ventilation. Washing facilities are provided. The place is clean and no cases were found. No lead was being used at time of visit.

Arms Co., No. 2, Blacksmith Shop. Lead is used for hardening special steel, none being used at time of visit. When in use is in a small lead crucible with no hood. Place clean, no cases found among the three workers.

Cartridge Department. This in on the first floor of the office building, and is a large light room, 70′ x 50′ x 12′. A lead cable is fed to a machine which cuts the size of bullet. The bullet is put in a tumbler then fed to another machine which swages on a brass or nickel jacket, other machines fasten the bullet into the cartridge.

The machines are all operated by females; at the lead slug machines (3), the girls alternate in feeding slugs and removing swaged bullet. The danger is in the handling of the lead cable and slugs with the bare hands, especially as females are very liable to lead poisoning. No gloves are furnished, and none were used. The place is very clean, and special toilet and washing facilities are being installed. The girls are very clean and no cases were discovered.

Cutlery Company. This firm manufactures razors, and uses lead during forging, and later in tempering. The forge room

occupies the first floor. There are eight forges, each supplied with a lead pot provided with a hood. There is one special hardening pot provided with a hood and exhaust fan. The place is clean, washing facilities are provided and men are given time to wash up. No meals are eaten in forge room. Air samples showed no lead, and no cases of plumbism were found.

File Company. Files are no longer cut by hand on a lead base but are made by machinery, lead, however, is used for tempering. This plant is a small one employing five men. There is one metal pot which is not hooded. The men are furnished gloves. No washing facilities are provided. No cases of plumbism were found.

Several large wire works were visited and it was claimed that lead was not used, lime and fish oil being the material used for hardening and tempering, and no evidences could be found that lead was used in the annealing ovens.

In several large plants where tempering of steel was done, they claimed that no lead was used, and that saltpetre was used entirely for tempering purposes.

In one plant, described further on, lead was used as an alloy with aluminum.

Smelting Company. This firm makes special alloys, babbitt metal and solder. At time of visit no melting was being done, and a number of workers were on a spree. There are 20 metal pots with no hoods and only natural means for ventilation in use. Fifty tons of lead a year are used. There are no facilities for washing other than cold water. No respirators or gloves are furnished, and meals are eaten in smelting room. No cases of lead poisoning were seen among those at work, but this is not conclusive that the others may not be leaded. Conditions in this plant need considerable improving.

Brass, Tinning and Soldering:

In the casting of brass, lead is added just before pouring the metal from the crucible into the moulds. The addition of lead makes the metal soft and less brittle, being necessary where the brass is to be turned in lathes. The amount of lead varies with the degree of softness required. Red brass contains practically no

lead, whereas the yellow variety contains from ½ to 5 per cent of lead. The principal danger is from the fumes, those exposed being the casters who place the lead in the crucible, and the moulders who pour off into the flasks. It is reported that the turners of brass are also liable, but no evidence could be found to confirm this statement.

Three large plants were visited having foundries, and a special description of these are given further on.

Brass Company. Casting room, 30′ x 60′, 20 feet high to Texas roof with louvre windows. Room is almost entirely open on three sides. There is one metal pot hooded. The percentage of lead used varies from 6 to 10%. There is no wash room or drying room, and meals are eaten in the foundry. General condition of the foundry is not good, and the workers are not careful as to personal hygiene. The caster who handles the lead admits having had lead poisoning, but shows no symptoms other than slight anaemia. Five other workers examined admit having had the "chills" (zinc poisoning), but give no evidence of lead poisoning. Analysis of air showed no lead present.

No symptoms were found among the brass turners.

Valve Company. This company makes valves and hydrants. Moulding. This department is situated in a building 120′ x 53′ and 18′ high, having a Texas roof with louvre windows. There are two Schwartz crucibles for melting brass. These are under a hood which is connected to the boiler stack. The percentage of lead used never runs over 4%. Forty men are employed in this department, none showed any evidences of lead poisoning, but several admitted having had the 'ague,' which is also another name for zinc poisoning.

Hydrant Department. Lead is used for caulking in brass nipples or nozzles, and there is one pot where babbitt is made; the pot is hooded. One worker has been at this for fifteen years, gives no symptoms, but has typical lead pallor. At time of visit he was heating his lunch at the lead pot. An anaylsis of sample taken at the breathing level of the lead pot showed 5 milligrams of lead per cubic metre of air.

Although general conditions in the place were good, no special precautions were taken against plumbism.

Manufacturing Company. This firm makes pumps and employs lead very seldom; the largest percentage used is 6%. The shops are ventilated by a combined plenum and exhaust system. Washing facilities are good. Thirty men are employed in the foundry, and no evidences of plumbism were found.

Tinning:

In the process of tinning lead is used when a dull or dead finish is required, about two-thirds lead being used. In the bright finish lead is practically never used except when the tin will not run good, then about 8-10% lead is used.

Harness Hardware Co. The tinning room occupied the fourth (top) floor of one of the buildings. The room was 40′ x 60′ x 12′ high, and contained pots for tinning and japanning. There was one pot containing tin for a dead finish, the percentage of lead was 66⅔. None of the pots were hooded, and ventilation was by natural means. No tinning was being done at time of visit. Washing facilities are provided. It was admitted meals are eaten in the room and no special precautions taken to avoid lead poisoning. There are six males employed, but no cases of plumbism were found.

Copper & Brass Co.:

Tinning Department. This is a portion of the rolling mill, which is practically entirely open on all sides. There are five tin pots hooded, and in front of each pot is an inclined bench about 7′ x 3′. A plate of copper is laid on the bench and a boy wipes it off with a jute mop wet with the flux, the tinner then ladles the tin out of the pot and pours it on the copper, the surplus being wiped off by another helper. No lead was found in the tin used, or in the air in the vicinity of the pots. No cases of plumbism were found. During the process there is considerable smoke. (Dr. Collis of Great Britian, recommends the hooding of the benches as well as the pots.) There are ample washing facilities. The helpers are Polish and Italian, the tinners Irish-American.

Casting Room. This is off the rolling mill and is 200′ x 50′, x 40′ high. The roof is Texas, louvred. The room is practically open on three sides. There are ninety pots or crucibles, the tops of

which are flush with the floor, and no yellow or lead brass was being cast. The highest amount of lead ever used is 2%. There are washing facilities, but men furnish their own gloves. Ninety men are employed, and no cases of plumbism could be found, though history of "chills" were given by many.

East Mill, Casting Room. This is a building 100′ x 150′, x 40′ high with a Texas roof louvred, the building being practically entirely open on all sides. The amount of lead in the brass used was 2%. There are six crucibles on the style of the Schwartz, and with no hoods. Sixty males are employed, but no cases of plumbism were found. There are washing facilities, and men are permitted to eat meals in the foundry. None of the workers were very careful as to matters of personal hygiene.

Soldering:

This is a process of fastening joints together to make them tight, it is usually accomplished by hand, though in the manufacture of cans it is often done by machinery.

In hand soldering the parts to be soldered are wiped clean and a dilute solution of hydrochloric (muriatic) acid used to remove oxides, sometimes rosin is used as a flux. A pointed copper iron, the tip of which is covered with tin (and known as the solder iron), is heated, and the tip is applied against a small bar of solder which melts and runs along the crevice or seam to be tightened.

The danger is from the fumes generated, and also from the handling of the solder in the bare hands. Some solder remains on the iron and this is liable to volatilize when the iron is heated in the small gas oven termed the furnace.

In the machines, the solder is placed in long troughs which are heated by gas. A traveller carries the can along and the seam dips into the solder, then a little further along, the surplus solder is removed by buffing wheels. In this process the danger is not only from the fumes of the solder pots, but also from the dust created by the buffing wheels, and in the oxides formed when the solder cools.

In soldering, the furnaces should be hooded, and in the machines, the solder pots and buffers should be hooded and

attached to an exhaust fan. All workers handling solder should have gloves.

Stamping Company, No. 1. In this factory both tinning and soldering were done. Tin pots were hooded and analysis showed no lead was used. Soldering is done all over the factory, gas furnaces, not hooded, used to heat the irons. Gloves are furnished to the workers and are used. No cases of plumbism were found. Some of the stamped ware is painted, and in the paint shop one man was found. He had been employed fifteen years, and though giving no evidence of symptoms, had the typical pallor of plumbism. Hot and cold water was furnished for washing. Meals were eaten in the factory. General conditions as to cleanliness were good. Air samples taken where soldering was carried on showed no lead.

Stamping Company, No. 2. This plant does tinning and soldering, but was shut down for inventory at time of visit. Analysis of sample from tin pots showed no lead. Both males and females are employed at soldering, and a patent soldering iron heated by gas is used. There was no evidence of there ever having been any cases of plumbism among the workers.

There is a special lunch room for the employees, also a wash room having hot and cold running water. General conditions in the plant are good.

Sprinkler Co. This firm makes fire sprinklers, but the only work requiring handling of lead done in the factory was soldering the fusible plugs in the sprinkler. This was in a small room 25′ x 25′ x 14′ high, on the third floor, and was well lighted. Five men are employed. There was one solder pot completely enclosed and piped to the chimney. Washing facilities were provided and no meals eaten in the room. No cases of plumbism were found.

In a number of plants visited, soldering was carried on, and is described further on.

Use of Lead or Tin Foil:

One large chocolate factory was visited where foil was used to wrap the chocolates in. Girls were employed at the work. The factory was a modern one with the best sanitary equipments and comforts for the employees, and all precautions were taken to

safeguard the health of the workers. An analysis of the foil used showed slight traces of lead present. No evidences of plumbism were found among the workers and the danger from the use of this foil is practically nil.

Tin Cans:

Can Co., No. 1. This is a large, light, airy one-story factory building 125′ x 125′ x 14′, with a saw-tooth roof. All work is done automatically by machinery. There are thirteen seam soldering machines and six end soldering machines. The solder pots and buffers on the machines are all under hoods connected with an exhaust system, and no fumes or gases are appreciable. Tests showed lead present, 3.6 milligrams per cu. metre of air. Sample taken at the lead pot of a seam soldering machine. There are ample washing facilities but no hot water. Soap is furnished and time given the workers to wash up in. No cases of plumbism were found.

Can Co., No. 2. This company makes its own solder.

Solder Department. This is in a building 60′ x 25′ x 14′ high, light and airy, five males employed. There are four solder pots hooded and connected with an exhaust fan. There is one machine for flat solder, the metal pot of which is hooded. No solder was being made at time of visit. The men wear gloves while at work. One of the workers, who had been there five years, had a slight pallor, but was rather a doubtful case. There were no special washing facilities and meals were eaten in the room.

Hemming room. This is a room 40′ x 40′ x 25′ high. A solder hem is stamped on the edges of can tops by machinery. Seven machines were in operation, with girls as operatives. There is danger in this process through contact with the lead and the workers should wear gloves. No cases of plumbism were found. Girls are cleanly and go home for meals.

Solder room. This is a large light room 175′ x 50′ x 40′ high. The roof is a Texas with louvre windows. There are four lines of machines. Machines are hooded, but, owing to changes being made in type of hoods, side seam soldering machine had no hood. A sample of air taken showed 2.6 milligrams of lead per cubic metre of air, and samples taken at end soldering machines which

were hooded showed 1.6 milligrams of lead per cubic metre of air. This was probably due to the disarrangement of the hoods over the machines. The temperature of the solder was 800° F. considerable below the point of volatilization. Gloves are furnished workers who handle the solder. There are no special washing facilities and meals may be eaten in the solder room. One worker who gave no history of symptoms had the blue line in the gums. Another worker complained of leg cramps and indigestion. Both were undoubtedly cases of plumbism. One case was reported from this factory, but could not be found.

Can Co., No. 3. This plant makes their own solder. Solder room is a small dark place off the engine room. At the time of visit it was closed.

Can soldering. This is a building 200′ x 75′ x 45′ high, the roof having a Texas with louvre windows. There are employed 200 males and 100 females. The females do not handle solder. All machines are equipped with hoods leading to exhaust fans. There are no special washing facilities and meals are eaten in the room. Tests showed no lead present, and no cases were found. There is room for considerable improvement in this plant.

Can Co., No. 4. This is a small plant where hand soldering is done. Only four men employed at soldering. Workers are supplied with gloves, towels and soap, there is also hot and cold water, but meals are eaten in solder room. No cases of plumbism were found.

Industries Where Lead Compounds are Used.

Paints and Colors:

In the manufacture of dry colors the pigment is first dried then put into mills for grinding. In the manufacture of paints, which are really oil colors, the dry color is put into a mixer, oil added, and by means of rotary paddles in the mixer the oil and color are combined and a body formed, which is used for paint. The principal danger in these processes is from dust created in handling the dry powder. After the color has been put in the mixer with oil, the only danger is from the material getting on exposed portions of the workers' skin and not being washed off properly.

Paint Works, No. 1. This is a small plant making oil paints, vermin exterminator and paris green. (See also arsenic report.) Both lead and arsenic colors are made. Very little grinding is done, and none at time of visit. The work is done on the second floor, the room being irregular in shape but averaging 60′ x 45′ x 14′ in height. No provisions are made to keep down or remove dust created in handling the dry color. Washing facilities are inadequate, and workers are unaware of the nature of the ingredients used.

One worker mixing and grinding for three years gave evidences of plumbism.

On boy, sixteen years old, at work on mixers for only a few months, had typical lead pallor and gave evidences of plumbism.

Paint Works, No. 2. This plant makes oil paints and putty. It is an old three-story brick building situated on the river front. Third floor. Here are two chaser mills, which are really large grindstones continually wheeling around in a circular receptacle, and so grinding the contents very fine, and at time of visit were not operating. The mills are entirely open, and when in use, the dry lead color is dumped in, oil added, and the chaser started. The result is considerable dust, and the heavy incrustations of lead on the floor and paint on the workers' clothes prove this. The color is run down through hoppers to the mixing machines on the second floor. Here all the work is done in oil, but the floor is covered with thick layers of paint, and the workers' clothes and hands are covered with it. The percentage of lead used is about 25. There are no washing facilities and meals are eaten in the factory. No provisions whatever are made for taking care of dust, and the workers, mostly foreigners, know nothing of the dangerous nature of the materials used.

One worker was found with the blue line of the gums.

Another worker had typical lead pallor. Neither gave any symptoms, but both were undoubtedly leaded.

The building is unsanitary, and vast improvement will have to be made to make it safe for workers exposed to lead.

Paint Works, No. 3. This is a large plant making oil colors; white lead was formerly made, but not any more. A large part of the output is a paint having baryta and zinc as the basis in

place of lead, and which, it is claimed, does equally as good work as a lead paint.

The building where the lead paint is made is three stories, the upper stories being used for mixing and grinding. At the time of visit no grinding of dry lead was being done. The colors after being mixed in oil are filled into cans for sale purposes. Nine males and three females are employed. Hot and cold water, soap, and individual towels are furnished by the firm. Rooms are partitioned off the mixing rooms for hanging up clothes and eating lunch. The majority of the men and girls ate their lunch in the mixing rooms, and the superintendent did not think it of much moment. But few of the workers washed up before eating, and none seemed to attach any danger to the use of lead in the work. No hoods were provided for the chaser machines, and no special means were installed to take care of any dust created.

Putty room. This is a one-story building, 25′ x 40′ x 10′ high. There is one large chaser mill entirely open. Very little lead putty is made, when used it varies from 8 to 35% lead, the rest is whiting, linseed and corn oil. The danger is when the dry material is placed in the chaser. At time of visit there was no dust, and so no lead showed in air samples. Two men are employed. No cases of lead were found among the workers, which is rather strange considering conditions found at time of visit. There is room in this place for improvement of conditions.

Paint Works, No. 4. This is a small plant making oil paints. Only a little mixing was being done at the time of visit. The place is clean, light, and airy. There are but two or three workers employed beside the proprietors. Washing facilities are ample, and care taken to clean up personally. No meals are eaten in the paint room. No cases of plumbism were found.

Paint Works, No. 5. This is a small plant, employing three men. Place is light. No dry colors were being handled at time of visit. Hot and cold water, soap and towels furnished. One worker admitted having been treated for lead poisoning two years ago, now shows no symptoms. This man chews tobacco. General conditions good, but no provisions to keep down dust.

Four other plants were visited, but no lead was used, as they made metallic paint, which has iron as a basis.

Varnish:

In the manufacture of varnish lead is used to color and aid in quick drying. The lead compounds used are lead acetate, litharge, and red lead. The varnish is placed in large kettles and heated, while heating, the litharge mixture is sprinkled over the top, then mixed in.

The danger is from the dust, both in the mixing room and while sprinkling on top of the varnish kettle.

Varnish Co. This firm makes varnish and enamel, the latter being really a colored varnish.

Dryer or mixing room. This is a small room 20′ x 15′ x 12′ high, having one skylight in roof. The colors are kept in bins, and when weighed out a scoop is used, there being no provision to take care of any dust created. At time of visit no mixing was being done. The men wear gloves; and of three seen, none showed evidences of plumbism.

Chimney room. Here are five chambers, about six feet square, with an opening in the rear leading to a large chimney, and a coal furnace in the centre of the chamber. The large kettles of varnish are run into the chamber over the furnace, and the worker sprinkles the lead mixture on top with a shovel. From observation, most of the dust is carried away from the worker toward the chimney opening.

On one floor of the main building color mixing is done dry for making enamels. But one worker was seen at time of visit, he wore respirator and gloves, but no mixing was being done. The mills are all tightly enclosed, but there is no method to handle the dust created in scooping from the barrels to the mills.

The firm tries to have a sanitary factory, special wash room with shower baths is provided, and towels and soap furnished. In the majority of the other processes in the plant, dust and fumes are handled by hoods and exhaust systems. No cases of plumbism were found or reported from this plant.

Oilcloth:

But one factory outside of Greater New York makes oil cloth. In this plant baryta and zinc have replaced white lead as a basis for colors, and they claimed lead colors are not used at all. This

firm makes their own varnish, and in this process litharge is used. The amount used varies from three ounces per gallon of linseed oil to eight ounces per 100 gallons of linseed oil, depending upon the heaviness required.

It was admitted that chrome (lead colors) were used at times, also that several years ago there had been some cases of lead poisoning among the workers who handled the varnish containing the small percentage of litharge.

The plant consists of a series of old one-story brick structures. The mixers are situated in rooms which are practically all open, but with no provisions for taking care of the dust created in putting dry color in. There was being installed at time of visit a dustless mixer. The colors are carried by an inclosed elevator to an upper platform and then dumped into the mixer, the entire process being enclosed so as to keep down the dust.

Linseed oil room. This is practically an open brick building, 100′ x 50′ x 15′. The pots are on top of a brick furnace. Over the pots is placed a cloth hood, connecting with an iron vent pipe, to remove fumes. The oil is pumped up into the kettles, and the worker sprinkles the litharge on with a shovel. During this process very little dust was noticeable. There are washing facilities, but no gloves, respirators, soap or towels are furnished. The workers do not seem to realize there is any danger from the lead used. Most of the workers wash up, and go home to meals. No cases of plumbism were found.

Artificial Leather:

This is practically oil cloth, and is made in the same way, with the exception that the coating is a secret process in which nitrocellulose (gun cotton) is used.

There is but one plant in the State making this material, and the danger from lead is in the use of chrome colors. Arsenic colors are also used at times.

The colors are mixed into a paste, then carried to the machine (which is long and enclosed), here it is placed in receptacles at one end of the machine and applied evenly to the backing fabric by means of rollers. The long enclosed runway is for drying purposes.

In oil cloth, after drying on of pattern, the fabric is run through a set of rollers and varnish poured on, then into another drying room.

The danger from lead poisoning in this plant is confined practically to the compounding room, from the dust created in handling the dry colors, and in the mixed product adhering to the unprotected skin.

The mixing building is 100′ x 100′ and roof averaging 14′ in height. There is a marked odor of amyl present from the nitrocellulose used. Six males are employed. The colors are dumped into open pans and caster oil added. During this process there is quite some dust. The mixture is then run through a set of rollers to thoroughly mix, and is then put in cans and taken to the coating room. The lead colors are used as follows, white lead 2%, chrome green 20%. The analyses of the air taken near the mixing failed to show the presence of any lead, but upon microscopic examination, fine green particles were seen which undoubtedly were chrome green, proving that very minute quantities of lead compound were present in the atmosphere as a result of mixing. No special means were provided to take care of dust created during course of mixing. The coating rooms were undergoing alterations at time of visit. Washing facilities are provided, and no meals are eaten in the factory. The company has a physician, but no cases of plumbism were ever reported, and none could be found at time of visit.

In this plant there should be a system of ventilation, and an exhaust system to take care of dust and fumes.

Potteries:

A special report on the pottery industry will be found in the report of the Commissioner of Labor for the year 1909. In it are described at length the various processes. In this investigation attention was directed mainly to the processes where lead was used. These are glazing and decorating.

In glazing there has been considerable controversy as to leadless glazes, the best of authorities agreeing that lead is necessary, but the danger may be minimized by using fritted lead, which is raw lead, borax and silica fused together at a high temperature.

The majority of the potteries decorate either by hand or by means of litho transfers, and some make their own transfers. This, of course, is really a branch of the lithographing industry, and the danger resulting is from the dust arising in handling colors containing lead.

Pottery No. 1 (see Plant No. 1, 1909). Conditions were changed since the time of the special investigation, it was noted that in the glaze dipping boys who had been assistants when last seen were now dippers. Conditions as to cleanliness are somewhat better, and aprons are furnished in the dipping rooms, also soap and towels.

Front dipping room. One male and two females. Female helpers' hands were washed after four hours' work and samples of the water analyzed. There was found 2.1 grams of lead, showing the danger of handling food without washing hands first. This was only from handling the ware after it came from the dipping tub.

Rear dipping room. Here were four males and eight females. No cases of plumbism were found. One of the dippers was a robust young man who at time of last visit was a thin boy acting as assistant. The workers all declared they washed up thoroughly, and at time of visit they did, which may account for the absence of cases.

Hand decorating room. This is a small light room on the second floor. There were six females applying colors by means of a small brush. Small girls grind the colors in oil, using a mortar, which is usually their first job, for after a few weeks at this they go at bench work. In the large decorating room are a number of young women and men who line the ware (decorate with fine stripes) with bronze color. Often the china is tinted. This is done under a hood connected with an exhaust. Tinting is usually done by young girls.

In the making of the litho transfer a press is used, and the color applied to an engraved plate. A very thin paper is run between the color plate and rollers and receives the impression. Young girls cut the paper into strips for easy application to the ware. The transfer, color side to ware, is applied, rubbed with a small tool to aid in fastening design, and then the paper is cleaned off, leaving the color design on the ware.

As the colors used in decorating are ground in oil, there is little dust seen in this portion of the work. There is a wash room, with hot and cold water, and soap and towels are furnished. Meals are eaten in the decorating rooms. No cases of plumbism were found.

Plant No. 2 (see No. 2, 1909). This pottery is one of the largest in the State. An attending physician is employed, and printed notices warning of the danger from lead are posted throughout the building.

Dipping room. Three male dippers and three boys to carry dipped ware to drying rack were employed. Gloves are not used by the dippers. Because of the high temperature and the stacks of dipped ware drying, it is a difficult matter to keep the room free from dust. Fritted lead is used in the glaze, and the dipping room is kept dampened during the day, and thoroughly cleaned at the end of the work day. Analysis of sample of air taken in the centre of the dipping room showed lead, due undoubtedly to the slight dust from the drying ware. In cleaning the glazed ware before going in and after coming from the kilns, all work is performed under hoods, and dust is removed by exhausts.

In the lithographing department 12 females are employed. After the litho transfers come from the presses they are dusted with flour by hand, then run through a machine to dust off the flour. All processes of hand dusting are done under hoods, and all machines are provided with exhaust systems. Twelve quarts of milk are furnished daily to the workers.

The general conditions in this plant are excellent for a pottery. Washing facilities are provided, no meals are permitted to be eaten where lead is used, and the workers are encouraged to observe the rules of personal hygiene. No cases of plumbism were found among the workers, and no cases were recorded by the physician.

Another large pottery was visited, but no work was being carried on. It was evident that means were being taken to make it as sanitary as possible upon resuming operations.

In the report of the British Commission as to lead in potteries, they attach the greatest danger to the use of lead in glazing, and find that in the color portion of the work there is not much cause

for alarm. While the amount of lead used in the decorating of china is small in comparison to glazing, and the amount of dust encountered slight, the danger is present, and the workers should be as carefully guarded as where the danger is greater.

Glass. There are two kinds of glass manufactured. A flint glass containing no lead, and used principally for bottles, and a glass containing lead compounds, and other poisonous ingredients. (See also arsenic report.)

The purpose of the lead is to make a glass that is soft enough to work, as in making art glass, and some compounds are used for coloring purposes.

The lead and other compounds are weighed and mixed in one room, then taken to the furnace room and mixed with a quantity of old glass; the entire mixture is then put into the furnace or pot, and fused. The material in the pot is kept in a liquid state by high temperature, and into this the glass blower dips his pipe, taking out the amount he wishes to work.

The greatest danger is from the handling of the dry ingredients, and inhaling the dust created during the weighing and mixing.

Six glass factories were visited, but analyses of material showed but two of them used a lead glass.

Glass Works, No. 1. This is one of the largest glass works in the world, making glass of all colors and for all purposes. There is a small emergency operating room in connection with the plant, but no regular attending physician.

Mixing Room. This is a long room off the old furnace rooms. Several males are employed here, and there are two large mixing machines. The material is weighed out and shovelled into an open trough. After the full amount is put into the trough, it is taken to the mixers and either shovelled in, or dumped into a receptacle which is hoisted to the top of the mixer and there dumped. During the processes no measures are taken to carry away the dust created. The men are furnished respirators but none wear them. No special washing facilities are provided, and the men ate their meals in the room. The help are all foreigners and not clean.

Two cases of plumbism were found.

One worker had been there thirteen years, and had been sick with muscular pains for one year. Blue line of gums was marked.

Another worker had been there a little over a year, he had epilepsy, also complained of muscular pains and showed a marked blue line of the gums.

The new furnace room is as near perfect as such a room can be. The only danger is to the workers mixing the ingredients and dumping into the furnaces. No precautions are taken to guard against dust.

Analyses of samples taken in mixing room showed 3.3 mg. lead per cubic meter of air. This shows the danger present.

None of the workers exposed to the danger are aware of it, and as they understand very little English, it is hard to make them understand. There is room for considerable improvement in this plant.

Glass Works, No. 2. This is a large glass works making art glass. At the time of the visit no mixing was being done. Lead is used in the form of litharge, red lead, and chromes. The mixing is done in an old portion of the building, but a new mixing room is under course of construction, and will be made as hygienic as possible.

The furnace room is not very well lighted, owing to the building being an old stone structure. Samples of air taken near the furnaces failed to show any lead upon analyses.

There are no special precautions taken in this plant beyond furnishing respirators to the mixers, who will not wear them. The majority of the help are foreigners, and have no knowledge of the danger of poisoning from the ingredients used. Washing facilities are inadequate, and the majority of the help do not wait to wash up before leaving, or eating meals. No cases of plumbism could be found, but none of the mixers were seen, which may account for this fact.

Cut Glass:

The manufacture of cut glass consists in cutting designs and patterns on a piece of glassware known as a blank. Most of the glass cutters have the blanks made by the large glass works. The process of cutting is as follows.

The design is first cut into the blank by emeries, and is termed rough finish. The design is now gone over with a pumice finish termed a smooth finish. During the cutting processes, sand and

dirt get into the designs and must be removed, so the ware is washed in soap and water, but as this fails to remove all the silica, stronger measures are necessary. The ware is coated with paraffine and beeswax, leaving the surface to be cleaned free, and is then dipped into hydrofluoric acid. The acid dissolves the sand and silica, and would also dissolve the glass, but it is quickly transferred to sulphuric acid to neutralize further action. The ware is again rinsed in water and sent to the refinishers. Here the glass is treated with wooden or felt wheels, and also brushed with a putty containing lead and tin. The ware is cleaned and finally wrapped in tissue paper for the market.

The danger from lead poisoning in the industry is in the use of the putty, and the workers who refinish and handle the ware after putty finishing are most exposed.

The polishing with the putty is a wet process, but the material scatters all over and dries quickly, so that there is quite some dust containing lead resulting from the work.

Factory, No. 1. This occupied several floors in one of the buildings of a large glass works. One floor was devoted to cutting and finishing. But two men were using putty at time of visit. The process is a wet one, and workers' clothes as well as hands and face were spattered with the material used. Very little information could be secured as the workers were foreigners, and no cases of plumbism were seen, though one case had been reported to the Department as having worked in this place. There were no special facilities for washing, and meals were eaten in the work rooms. The workers had no knowledge as to the poisonous nature of the material used.

Factory, No. 2. This plant has its blanks made by a large glass works. The refinishing room is 70′ x 40′ x 25′ high, and very light. There are 12 males who alternate on the different processes including the putty finishing. The men are mostly Italians, but understand that lead is used in the putty. Soap is furnished for washing. Respirators are furnished the men but not used. The place is kept clean, but the workers do not follow the rules of personal hygiene very closely.

Six cases were found showing the blue line of the gums, but only four gave any symptoms, these suffered from indigestion and muscular pains.

This firm made its own putty in a special outbuilding. The room was 20′ x 30′ x 10′ high, well lighted. There were two pots hooded. Only one worker employed, and he was not in the room continually. Lead from the lining of tea chests was used, and the proportions were two-thirds lead and one-third tin.

In this industry the principal measures to be taken are cleanliness, especially on the part of the worker. While there may be some dust in the air it is negligible, as the results of our analyses failed to show any lead present in the samples taken.

Rubber Goods:

In the manufacture of rubber goods lead compounds are used as an aid in vulcanizing, curing or hardening of the rubber as well as for pigmentation or coloring purposes.

After the gum rubber has been thoroughly washed to remove the dirt, it is put through a masticator, which is a machine having revolving rollers which makes the rubber smooth and firm. The rubber is now run through a set of rollers in the machine called the grinder, and the pigment compound gradually added until it is thoroughly mixed. Sometimes the addition is done at the masticator, as both machines are similar in their action. The rubber is now ready for any purpose, and in many cases is made into material which is vulcanized, that is, put into a heating chamber, and, with the addition of sulphur, made hard and durable. The temperature of the chamber is not sufficient to volatilize the lead, and merely causes a uniting of the sulphur and compound to form a sulphide. The rubber is dusted with talc or chalk before going in the chamber, and the sulphur mixture is placed in a small vessel on the floor inside of the chamber.

The danger exists principally where there is dust created in handling the dry pigment combination, such as mixing and masticating.

It is claimed by some authorities that poisoning has occurred from handling the sulphide, but if this is true it is only in isolated cases.

Samples of air taken at the heating chambers and in the finishing of the vulcanized product showed no lead present. An analysis of rubber as it came from the mixer showed about 25% lead present, and an analysis of the vulcanized product showed almost the same percentage, showing that the danger is practically confined to the compounding and mixing.

Five plants were visited where lead was used in the rubber, three are described under electrical works.

Rubber Co., No. 1. This is a large plant manufacturing rubber goods for all purposes, and of all colors. The building is a modern four-story concrete structure, ventilation by natural means.

Weighing room. This is a large light room on the first floor, partitioned off from the mixing room. Ingredients are kept in bins, and hand scoops are used in taking material out to be weighed and sifted. No special means are installed to carry away dust generated during the handling process. New mills are being installed wherein mixing, weighing and filling of containers is all inclosed and no dust escapes. At time of visit no mixing or weighing in this room was being done. Samples of air were taken, but showed no lead present.

Mixing room. The machines were in separate inclosures, but with no exhaust connection to handle the dust. A sample taken in one room during putting in of ingredients showed eight milligrams of lead per cubic meter of air. The worker was covered with dust, had been fifteen years in the factory, two years at mixing, and yet showed no evidences of plumbism. He claimed to be cleanly, and did not drink or use tobacco. All the workers engaged in the weighing and mixing processes were covered with dust, and did not use the respirators furnished. No cases of plumbism were found.

In the rubber, litharge and chromes are used, and it was stated that to every pound of rubber there was about three-quarters of an ounce of litharge, which does not seem to agree with the findings of our analyses.

Analyses of air were taken in the cementing room, where the vulcanized product is assembled and finished, but no lead was found, due to the fact that the room was extremely free from

dust. No cases of plumbism were found. It was admitted that the workers in this process are very migratory, and mostly foreigners who understood very little English. But in my opinion there is very little danger in handling the vulcanized product.

The firm has adequate washing facilities on each floor, they furnish the workers exposed to dust with respirators, and try to keep the factory sanitary. The character of the help are not of a class who follow strictly rules of personal hygiene.

Rubber Co., No. 2. This is a small plant making rubber tubes and tires for motor vehicles. No weighing was being done at time of visit, and but one mixer running.

The compounding room is large and light, but no provisions are made for exhausting dust. There was one worker present. He had been here three months and was some four years in the rubber business. Was anaemic and gave history of gastro-intestinal trouble, and in my opinion was suffering from plumbism.

There were four mixers, none of which were provided with means for taking care of dust created. At the one mixer in operation no ingredients were being added. Gloves were furnished the workers, but there are no special washing facilities, and meals are eaten in the factory. There is room for much needed improvement in this place to make it safe.

Enamelled letters:

In this industry the letters are first cast and then enamelled in different colors. The casting material may be of lead or other metal, and the enamel is really a paint baked on. The danger is from handling lead and colors containing lead, and the fumes arising during casting of lead.

Plant No. 1. This is a small factory occupying a two-story frame structure. There are five males and fifteen females employed. There is one small metal pot not hooded. Letters are of cast lead, and when cool are finished by filing, which is done by the young women. There are no special provisions for washing, and workers go home to meals. The general condition of the place and workers as to cleanliness was good. No cases of plumbism were found.

Plant No. 2. This is a small plant employing three men. Fifty per cent lead is used in the material of which the letters

are made. The lead metal pot is small and unhooded. There are no special washing facilities, no meals eaten in the place. No cases of plumbism were found.

Enamelled Ware:

One large plant manufacturing enamelled household ware was visited. Analyses of the ingredients used for enamelling failed to show any lead present.

Dyeing:

Two large woolen mills and one large carpet plant were visited, and analyses of the dyes used and samples of fabric made failed to show any lead present.

Two large silk mills and one silk thrower were visited. In the preparing of silk, termed throwing, nothing is used but soap and water, with oil for finishing.

In dyeing and weaving of silk tin instead of lead is used for weighting or giving body to the silk, and no lead dyes are used. Samples of silk were analyzed and no lead found.

Shoes:

A number of large shoe factories were visited, but it was claimed that no lead preparations were used in dyeing or finishing. Samples of different preparation were secured and analyzed.

In two of the plants visited tan shoes were made, and before leaving the factory were examined and slight defects of finish were touched up with a tan dressing. But one or two men were employed at this work. The analyses of these tan dressings showed that they contained small quantities of lead, probably as a chrome. The average number of bottles used is about twelve a year, or twenty-four ounces of mixture. The workers handling the fluid were not very clean, but no cases of plumbism were found. It is evident that in this industry the only danger from lead is in the retouching of the tan shoes, and is limited to a very few workers.

Coated Paper:

Two large plants were visited where coated paper was made. It was claimed no lead was used, and analyses of the ingredients used failed to show any lead present. None was found in the air.

Harness Making:

A number of harness manufactories were visited, but no lead was found to be used in dressing or finishing the leather. In punching holes in various portions of the harness some workers used a small lead plate as a base, but many used a thick piece of leather for the same purpose. No cases of plumbism could be found, and it seems rather remote to classify the work as one liable to poisoning from lead.

Chemical Works:

One plant was visited where chlorine products had been made in a lead lined chamber (see also arsenic), but this had been done away with and concrete chambers were now used. They had never seen any cases of plumbism during this work.

One plant making sulphuric acid was visited. In this industry large lead chambers are used during the process of manufacture, and the acid at times becomes contaminated. Samples of the acid were analyzed, but no lead was found. Samples of the fumes in the plant failed to show any lead. No cases were found, and the superintendent said he had never seen any evidences of leading in all the years he had been connected with acid making. Poisoning in this industry is probably an uncommon occurrence.

Jewellers:

A number of jewellers were visited as to the use of lead. Some of the solder used contains a minute quantity of lead, but enough is not used to be dangerous. Formerly precious stones were set in a lead bed during the process of cutting and polishing, but plaster of paris is now used. The danger in this industry from such work is certainly not dangerous.

One large concern was visited where ornaments were made of lead and then enamelled.

The lead is melted in small pots which are provided with hoods and pipes. The lead is poured into small moulds and later on enamelled. Only males are engaged at casting.

In the enamelling, colors are ground and mixed in inclosed machines. The product when ready for use is an oil mixture, and there is no dust in its use. Small amounts of the colors are applied to the novelty (which may be of any metal) by means of

a small metal point. The novelty is then put into a special oven and at high temperature practically baked on. The ovens are hooded and piped to an exhaust pipe. Thirty females are employed in putting on the color or enamel, but none showed any evidences of plumbism, or were any cases known of.

While the quantity of enamel used by each worker is small, still there is the remote possibility of getting it into the system through lack of cleanliness.

Embroidery:

A number of embroidery places were visited and samples of the powder in use analyzed. No lead was found present. The only danger in this work would be from the use of lead carbonate as a powder for tracing patterns, but it seems very remote, as none of the manufacturers use it, or recommend its use.

Dairy Implements:

A number of cases of poisoning had been reported from a firm making a cream separator. A visit was made to the plant, and it was discovered that in a portion of the finishing process of some of the parts a black putty consisting of 65% lead was put on the metal part, put into an oven for baking, and after hardening was sandpapered.

The room was a large light room on the first floor of a new building, ventilated by a plenum system. An analysis of the air of the room showed no lead, but a sample taken at the breathing level of a worker while sandpapering showed 68.8 milligrams of lead per cubic litre of air, clearly proving the danger was from inhaling the lead-laden dust created during the process of sandpapering. The remedy in this case is an exhaust system.

Four cases of lead poisoning were found in this part of the plant.

One worker showed blue line of gums and had colic off and on for two months.

Another worker, employed one year, gave no history of any symptoms, but gums showed blue line.

Worker had been employed for eight months then remained away for eighteen months. Had slight blue line of gums and complained of wrist and arm trouble.

The star case was a worker who had been there for ten years and was being treated by a physician for stomach trouble. He was anaemic, had blue line of gum, and a marked paralysis (wrist drop) in both wrists. He was unaware of the fact that he was suffering from lead poisoning, and no one in the factory ever thought of such a thing.

This firm also does tinning and soldering. No lead is used in the tin, and no cases of plumbism were found in the tinning shop.

Soldering is done both by hand and machine in a large, light, airy shop. The machines are gradually replacing the hand work. Neither the solder pots of the machines nor the furnaces of the hand solderers are provided with hoods or exhaust systems. No cases of plumbism were found among the solderers.

The firm have ample washing facilities, but furnish no towels. They aim to have a sanitary factory, but do not realize the danger incidental to the use of lead. The workers should be instructed as to the danger, and special precautions, such as exhaust systems, use of respirators, and personal cleanliness, should be insisted on.

Several burial casket firms were visited, but they claimed that the only way lead was used was in soldering, and that to a limited extent. No cases of plumbism were found, and no conditions were found which would indicate any danger to the workers from lead poisoning.

Painting:

That painters are liable to lead poisoning is a common fact. There is no doubt that a large percentage is due to faulty personal hygiene. In indoor work there is no doubt a part of the danger lies in sandpapering or scraping paint, and it was with this phase of the work we tried to confine ourselves. The plants visited were those where vehicles were made. In order to get a good surface for a fine finish, the various portions of vehicles, but more especially the body, is sandpapered both before and after the application of paint. During the process of sandpapering a fine dust is created, and inhaled by the worker. If lead is on the part being sandpapered, there is, of course, danger of inhaling the fine particles set loose.

In the majority of plants, there is plenty of floor space in proportion to the workers, but on account of storing of stock which is

bulky, and the few workers grouping together, it is as bad as working in a confined space.

Seven plants were visited where vehicles were made.

Plant, No. 1. This is a large plant making carriages and automobile bodies. The floors of the various buildings were large, light and airy, with but few workers on each floor. No special washing facilities; and meals are eaten in the factory. No cases of plumbism could be found. It was difficult to secure information from the workers. Samples of air taken in the room showed no lead present, but a sample taken at the breathing level of one worker who was leisurely sandpapering a wheel showed 2.2 milligrams of lead per cubic metre of air, proving the dangerous nature of the work. A great many of the workers were anaemic and if every one could be given a strict physical examination, plumbism would probably be found to exist in many.

At quitting time, the alkaline sodium sulphide solution was applied to the hands of twenty workers who had washed up preparatory to going home. Fifteen showed the presence of lead still on the hands, proving uncleanliness, one of the causes of poisoning.

There seemed a disposition on the part of the workers to regard very lightly the dangers incidental to the use of lead, and, as a rule, most of them used tobacco for smoking and chewing.

Plant, No. 2. This is a small place devoted principally to repair work. Four men are employed. No sandpapering was being done at time of visit. Washing facilities consisted of a sink and cold water. All the workers chewed tobacco, and were careless in their habits. No history of any symptoms could be obtained, though two of the workers looked as if the anaemia was due to lead.

Plant, No. 3. This was formerly a large carriage factory, but now makes automobile bodies. The building is large and old fashioned, with poor light and badly ventilated, but the workers are few. No sandpapering was being done. No special washing facilities are provided, and the head of the firm sees no danger from lead. Meals are eaten in the shop. It was claimed that in 40 years only one case had occurred in the place.

Of the six men employed, two could be classed as leaded.

One worker had been nine years at outdoor work and one indoors. He was markedly anaemic, but claimed to have no symp-

toms, and there was no gum line. He chewed tobacco but was clean as to person.

One worker, 25 years of age, had been a painter for eight years. He gave no history and had no gum line. Examination showed him to be tubercular, and in my opinion leaded.

Plant, No. 4. Ten men are employed in this plant and in place of lead priming, a rub filler, consisting of shellac, japan dryer, barium sulphate, silica, and linseed oil, is used. No dry rubbing is done, water and pumice being first used, then sandpaper. Hot and cold water is provided, and men furnish their own towels. Meals are eaten in the factory.

The workers are very clean as to habits, and no cases of plumbism could be found.

Plant, No. 5. This is a large carriage manufactory, employing 50 men. No special washing facilities other than hot and cold water furnished. Meals are eaten in the facthory. The men are as a rule clean, but many use tobacco for chewing.

Two workers were seen who admit having been treated for lead poisoning a number of years ago, but claim that by being clean and careful they have had no return of symptoms. Other than slight anaemia, no signs of plumbism could be found. No cases were found among the other workers.

Another plant visited will be described under motor vehicles.

In the following plants there are a number of processes, each entirely separate from each other, but it is deemed advisable for the sake of clearness to describe each plant in entirety, instead of each process separately.

Printing and Lithographing:

One of the largest lithographing firms in the State was visited and studied. The building was a modern structure with all sanitary conveniences. The Departments taken up were color mixing, bronzing, pressroom, stone cleaning.

The plant was ventilated by means of a plenum system, and ample washing facilities, hot and cold water; soap and towels were furnished. The plant was kept very clean.

Bronzing. This was a large, light room, partitioned off the pressroom. All machines were entirely inclosed and connected with an exhaust system. One man cleaned up all dust with a

vacuum cleaner. Despite these precautions the room and the clothes of the men were covered with the bronze powder.

In Dr. Collis's report on bronzing, there seemed to be an opinion that lead poisoning from bronze powder is almost nil, and the amount of lead found in the samples of bronze powder submitted to the Government chemist contained but slight traces of lead.

This seems to bear out our own investigation. In a number of samples of bronze powder analyzed no lead was found present, and no cases of plumbism could be found among the workers.

Pressroom. During the lithographing, the pressmen get color on their hands and clothes, and, as the colors contain lead, there is some danger. None of the workers examined showed any symptoms of plumbism, but this may be due to the fact that they were cleanly in their habits. Twenty workers were tested after washing up, and no lead was found present on the hands.

Stone Cleaning. In order to use the lithographing stones again the color is washed off with benzine, the design ground off and the stone dressed. The workers engaged at these processes were all found to be very robust and exhibited no symptoms of plumbism.

Color Mixing. This was done in a large, light room. There were two grinding machines, and one pony mixer which was entirely inclosed.

One man did the color mixing and had been there a number of years. He gave a history of symptoms which indicated plumbism, and upon my advice decided to see a physician.

In order to determine to what extent the mixer was exposed, an analysis of wash water was made. The color mixer had been mixing chrome colors all morning, and at noon he wiped his hands as clean as possible with cotton cloth, and then washed them with soap and water. An analysis of the water in which he had washed showed 3.74 milligrams of lead carbonate, a further proof of the part personal hygiene plays in plumbism.

Printing:

Two daily newspapers were visited.

Daily, No. 1. Composing Room. This was on the top floor of an old building poorly ventilated. There were 21 linotype machines. On thirteen the pots were piped to a chimney, and on eight the pots were piped to an exhaust fan in the stereotype

room. All connections were poorly made. The floor is kept clean. Analyses of air showed no lead present. Of the 40 workers, none gave any evidences of plumbism. The foreman had been many years in the business and for years had set type by hand. He was gradually losing his sight and could not account for it. In my opinion, he was really suffering from the results of being leaded.

Stereotyping. This is a portion of the composing room. There are two metal pots heated by coal. Over the pots are collapsible hoods piped to a 24″ exhaust fan in the window. Analyses failed to show any lead present in the air. There were 5 workers, all robust, and no evidences of plumbism could be found.

Daily, No. 2. Composing Room. This was on the second floor of what had evidently been a former dwelling. The room was 70′ x 25′ x 12′ high, and contained seven linotypes the pots of which were piped to the periphery of a 30″ exhaust fan in window. The room is entirely unfitted for such purpose. No lead was found in the air, and no cases of plumbism were found.

Stereotyping. This was in the rear of the first floor and connects with pressroom. There is a sort of shaft extending 20′ upward from the ceiling and capped with a skylight having louvre windows. The place is not clean, and the one metal pot is hooded. No lead was found present in the air. The four workers were very robust, and showed no signs of plumbism.

This bears out the result of former investigation by the Department to the effect that the danger from fumes from metal pots are not very grave. The danger is from the oxides floating around as dust, and the dust from lead allowed to accumulate on the floor.

In order to determine the danger incidental to job or hand type setting, the worker on one paper washed up after setting type all morning, and an analysis of the water showed 1.30 milligrams of lead present. This is proof of the danger in handling material containing lead, and the necessity for perfect cleanliness in order to avoid taking it into the system.

Storage Batteries (Electric Accumulators.):

According to the Department returns, out of 67 cases of lead poisoning reported among indoor workers (23 of painters), 15 occurred among storage battery workers, which would seem to indicate the industry as a very dangerous one.

Storage batteries are made as follows:

First the grid is cast out of lead, it may be solid or have small perforations. If cast solid it is put through a machine to swage or roughen by finely scored lines. The grids are thoroughly cleaned of oil by means of benzine and are ready for pasting. The grids are used for the positives, and the sponge lead for the negatives. The grids are now smoothly covered with a paste containing a lead compound and sulphuric acid. They are then placed in tanks of sulphuric acid for 48 hours to form. The plates are again cleaned, burned off, and arranged in series. The smaller posts and connections are soldered in and the batteries made up in different sizes as required. There are different types of batteries and the process varies somewhat with each type.

Plant, No. 1. This is a large concern making a modification of the Planté cell, and also the paste type.

Casting Room. This is an open room 60′ x 25′ x 14′, there are six lead pots with no hoods or exhaust system. Of the twenty workers, ten are young boys engaged in trimming the lead grids. Gloves are worn during the process, but the place is dirty. Analyses of the air of this room showed 3.4 milligrams of lead per cubic metre of air.

Pasting Room. This is just off the casting room. Despite the fact that the tables on which grids are pasted have an exhaust attachment, the room is not clean. There are seventeen employees who wear gloves furnished by the firm. Little attention is given by the workers to whether the gloves are in good repair. Where attention was called to gloves in bad shape, and new pairs were given out, the workers started to put their dirty hands in the new gloves, illustrating how little attention is paid to personal hygiene.

Analyses of air in this room showed 4.2 milligrams of lead per cubic metre of air.

Assembling. This is a room 60′ x 50′ x 30′. Ventilation is by natural means. Here the plates are burned off by means of a small bunsen torch, and then soldered together in series, or groups, and placed in sealed cells. There are only a few workers at each branch of the work, and they sometimes alternate. No gloves are worn, and there are no special devices for removing dust or fumes. A sample of air taken at lead burning bench during work showed

2.6 milligrams of lead per cubic metre of air, emphasizing the need of an exhaust system. The tables are dampened several times during the day, and the floors cleaned, but this does not remove the danger.

Hot and cold water, soap and towels are provided for men in lead processes, and cathartic pills are furnished free. The hands of ten workers who handled the pasted grids were examined after they had washed up, and lead was found present on all.

Three cases of poisoning occurring in this plant were reported to the Department. During the visit the following cases were found.

Casting. Three of the boys engaged in trimming grids showed typical anaemia, but as they could speak no English, further information could not be secured. They were all under 18, and had been working several months.

Pasting. Information was hard to secure, as workers spoke little English. One case worked three months. Anaemic, marked line on gums. Polish worker, no history could be obtained. Anaemic, line on gums. Four cases were seen with marked pallor, but no history could be obtained.

Polish worker being treated by a physician for lead poisoning but still continuing at work.

Assembling. Two lead burners reported to the Department showed marked symptoms and still continued at same work.

One lead burner, employed ten years, gave no history, but had well marked anaemia and gum indications.

In a small room off the pasting room the weighing and mixing is done. No means are taken to keep down the dust, and the worker is a Pole who understands no English, and showed evidences of plumbism.

General conditions in this plant need remedying. There is need for measures to take care of dust and fumes. The workers should also be informed of the danger of poisoning.

Plant, No. 2. This is a large plant making Planté and paste batteries. Each department is in a separate building.

Casting. This is a large, light building with mechanical means for ventilation. All metal pots are hooded, and men wear respirators and gloves. Despite these precautions, an analysis of the air

at the pots showed 1.0 milligram of lead per cubic metre of air, probably due to oxides formed on cooling of metal, or carried in by workers coming from the pasting department.

Pasting Room. This is a large, light room, and pasting is done on tables provided with an exhaust. Twenty workers are employed, mostly foreigners who speak no English.

The men are furnished gloves, but they are of little protection as the workers take them off, handle the lead with bare hands, and then put the dirty hands back into the gloves. Despite the exhaust system, the workers slop the paste over the floor and on the benches. The air analyses showed 1.2 milligrams of lead per cubic metre of air. The foreman said it was hard to get them to keep clean, and despite orders against eating, they would bring in sandwiches and eat them with dirty hands. As an example of uncleanliness, the condition of the drinking water cooler was proof. Upon taking off the cover, red lead was seen on top of the water, so it was no wonder the workers were poisoned.

Just off the pasting room was the weighing room. Here every precaution was being taken. In every process where the dry lead was handled, such as weighing and mixing, it was done under a hood connected with an exhaust. The workers wore gloves and respirators, and were careful in all their methods of handling the lead compounds.

Forming Rooms. These are in separate building, light and airy, but no special means for removing acid fumes from tanks. Workers wear rubber gloves. There are never more than five men at work in the rooms.

Assembling. This is a large, light building. There are only eight workers on assembling.

Burning Off Room. This is a large light room. Ten men are engaged in burning, and ten in soldering. A machine for group soldering has been installed and is equipped with an exhaust system; this does much to lessen the danger. The men are not as careful as they might be in these departments, though means for protection are furnished by firm who endeavor to keep the rooms free from dust. An analysis of the air at the burning off benches showed 1.8 grams of lead per cubic metre of air. This is conclusive that there is danger attending this process.

The firm endeavors to protect the workers as far as it is possible for them to do so. Wash rooms with hot and cold water and soap powder are provided, and workers are allowed fifteen minutes to wash up in. Tests of workers who merely used soap showed that lead was not all removed, whereas those who used the washing powder showed no lead. Gloves and respirators are furnished, but in many cases are not used.

Despite all the precautions taken in this plant, there were thirteen cases reported to the Department as occurring among its employees. Most of these cases were found to be among the pasters.

During the visit, four cases were seen in the pasting room, and a greater part of the workers looked suspicious.

One case was found in the assembling room.

One case was found in the burning off room.

One case was found in the forming room.

I am of the opinion that in this plant the many cases are due to faulty personal hygiene, and emphasizes the fact that the workers must be educated, and warned of the danger.

The greatest danger seems to be in the weighing of the ingredients, and the pasting of the grids, due to the large quantities of dust containing lead oxides. There is less danger in handling the negative plates which contain lead sulphate and are hard. The positive plates are composed of lead oxide.

There is no doubt of the dangerous nature of the storage battery industry, and the need for measures applicable not only to the industry, but also to the employees, is fully emphasized.

Electrical Equipments:

Plant, No. 1. This firm makes various electrical supplies, and comprises a lead cable department, a brass foundry, and numerous assembling departments. The departments where lead is used are as follows:

Brass Foundry. This is in a large, light building, 50′ x 60′ x 25′ high, the roof being a Texas with louvre windows. There are 9 crucibles, the tops of which are flush with the floor. The lead used does not go over 5%. Seventeen workers are employed The caster had been at this sort of work for seven years and gave no history of plumbism, but showed a faint line in the gums. In my opinion he had some lead absorption. No other cases were

found. There were no special provisions for washing other than hot and cold water, and meals were eaten in the foundry.

Cable Department. This was in a room 100′ x 300′ x 12′ high. There are three machines, the metal pots of which are not hooded. Eight men are employed, and none wear gloves which are furnished by the company. Meals are eaten in this room.

No lead was found upon analyses of the air, due probably to the enormous air space, and but one machine working.

Pocket Lamp Battery Department. In this room some hand soldering is done by females, and lead foil used in making batteries is handled by girls. No work was being done at time of visit.

The general conditions of this plant are fair, but no special precautions are taken to guard against lead poisoning. One case was reported to the Department as occurring in a cable worker in this plant. This worker was not seen, but there was seen another case in this department. He was anaemic, and the gum indications were marked.

Plant, No. 2. This plant makes cables, and has a rubber department and a lead department.

Rubber Department:

Weighing Room. This is a large room with a balcony for reaching the hoppers of the mills. The mills are enclosed, but there are no special means for dealing with the dust created in handling the dry materials used. The room is quite dusty, and but one worker was seen wearing a respirator. An analysis of the air of this room showed 1.0 milligram of lead per cubic metre of air.

Incorporating Room. This is a long room off the cable room. There are 4 rubber washers, and 6 incorporating machines, which are merely sets of revolving rollers set close together. There are no special means for handling the dust created during process of feeding the incorporators. There is a muslin hood over the top of each machine, but this is to prevent dirt getting into the rubber mixture. The floor is kept clean, but an analysis of the air showed 2.9 milligrams of lead per cubic metre of air. None of the workers wore respirators or gloves.

Lead Cable. This is in the main building which is spacious. There is one lead cable machine, the metal pot of which has no

hood. There are eight men employed. Very little attention is paid to their personal appearance, and in handling the lead, gloves are seldom worn. No lead was found in the air.

The company furnish no means for safeguarding the workers against lead, and washing facilities are merely running water. Many improvements are necessary to make the work safe.

One case of lead poisoning was reported to the Department as occurring in a worker at this plant.

Four cases were seen at time of visit.

One worker in the weighing room had gastro-intestinal trouble and showed signs of beginning nervous trouble.

Three workers at the incorporating rolls had typical lead anaemia, but gave no history of illness.

Plant, No. 3. This plant makes copper wire and has a rubber department. At time of visit alterations were being made in this portion of the plant. The principal danger in this place was confined to the weighing of the pigments and the mixing of the rubber. The weighing room was a small closet like room, and one American did all the weighing. No special means were used to keep down the dust, and no respirator was worn. The mixers were in the main room, but not provided with any exhaust system. It is intended to put this department in a separate building. No cases of plumbism were seen.

Plant, No. 4. This is one of the largest manufacturers of electrical goods in the world. The various departments are, in some instances, industries in themselves. Each department has its own building. The following departments were visited:

Brass Foundry:

This occupies a building 250′ x 100′ x 30′ high, well lighted, and ventilated by natural means. 110 men are employed. There are seven crucibles arranged under a shaft leading to roof. Seven under a large hood with duct to roof, and two single crucibles, each with a hood and duct connection to roof. The amount of lead used in the brass varies from ½ to 4%. Excellent wash rooms and lavatories were in the building, but no towels were furnished. No cases of plumbism were found, and the foreman had never heard of lead poisoning among the brass workers. Many admitted having had the "chills."

Cable Department. This was carried on in a building 200′ x 100′ x 30′ high. There were four machines, the lead pots of which were not hooded. The workers wore gloves. No lead was found in the air, and no cases of plumbism were seen.

Rubber Work:

Weighing Room. This was a room partitioned off the main portion of the second floor. There were a number of grinders and mills, and a balcony for feeding bolting machines. There was no exhaust system for handling the dust, and on one side of the room two 30″ exhaust fans were set in the window. The place was very dusty, and upon attention being called to the action of the fans in making conditions worse, they were stopped. In the mixtures used, as high as 70% litharge was used. An analysis of the air showed 6 milligrams of lead per cubic metre of air. Meals were eaten in this room.

Mixing. This was done on the first floor, the room measuring 300′ x 100′ x 14′ high. There were 10 rolls or masticators, and are used for incorporating the pigment in the rubber. None of the machines have an exhaust system. Respirators are furnished but not worn, as it is claimed they irritate the face. One-half hour is allowed for meals, which are eaten in the same room. Workers do not wash up, claiming they have not sufficient time. Analyses showed 0.5 milligrams lead.

Seven cases were found in this department, all gave evidences of colic and muscular pain, were anaemic, and had the gum line.

It was strange that this department should be so lacking in safeguards, as in another department (described later), where machines of a similar character were in use, exhaust systems were installed.

Insulating Department. In this department some litharge was used. All mixers, masticators and calenders were equipped with hoods connected with an exhaust system. All weighing and handling was done under hoods.

In one of the buildings, hand soldering of small parts is carried on. There are ten pots hooded and connected to an 8″ exhaust fan. Girls are employed at the soldering. No cases of plumbism were found.

The washing facilities in each building are splendid, but no towels are furnished. There is a small emergency hospital in the

plant with a nurse in constant attendance, but there is no regular attending physician.

A conference was held with the manager and heads of departments, which resulted in measures being at once taken to remedy faulty conditions.

Motor Vehicles:

This is a large plant and comprises a number of departments connected with machinery and vehicle manufacturing.

Foundry. This is a large, light, airy concrete building at the river front. 18 males are employed. Brass and aluminum are cast. It was admitted that lead was used in both mixtures. Lead was found in the air 2.58 milligrams per cubic metre.

Machine Shop. This occupies the floor of an old building and is divided into various lathe and turning operations. The aluminum metal is used for running boards and for gear cases. The foreman did not know there was any lead in it, and asked if lead was a poison. In one portion of the room were two workers casting babbitt bearings. Pots were not hooded.

Paint Shop. This includes portions of two floors and one small building, and is devoted to finishing automobile bodies. There were 40 men engaged in painting and sandpapering. None had been with this firm very many months. Most of the men chewed tobacco and were not very clean. Two admitted having suffered from plumbism, and one remarked that " if painters would keep clean they would not be leaded, as he had learned by his own experience."

Washing facilities are inadequate, and no special precautions were taken to insure cleanliness. Meals were eaten in all parts of the factory.

One case was reported to the department from this plant. He was a young foreigner and had been doing painting. When seen he was at work in the machine shop. The only symptoms he showed was slight anaemia, and had cramps once in a while.

In the paint shop ten of the workers had a typical lead pallor, and in the babbitt casting the two workers showed evidences of being leaded. Tests made on the hands of some of the painters showed they did not remove the lead by washing.

Conditions need remedying in this plant, especially in the processes where the workers are exposed to the action of lead.

A number of factories were visited where processes were carried on in which it was reputed there was danger from lead. Among these were musical instruments, making of colored cloth, artificial flowers, brush makers, hatters and lacemakers. But no evidence could be found in support of this theory.

Conclusions.

The result of the investigation has brought forth a number of important facts, many of which confirm the findings of previous investigators, and emphasizes the need for further scientific investigation.

That danger exists in many industries is clearly proven. In many instances the proprietors themselves are unaware of the presence of lead in the material used, or the danger therefrom.

It has been shown that in some industries other ingredients have been substituted in the place of lead.

It is apparent that medical supervision is necessary for workers exposed to lead and its compounds.

There are certain industries more dangerous than others, and for these, special regulations are necessary, such are white lead works, colors, paints and varnishes, potteries, storage battery works, smelting and making of alloys, solderings, rubber goods.

Lead poisoning can be prevented by proper removal of all dust, fumes, gases and vapors, and by cleanliness on the part of the worker.

It is clearly shown that many of the workers do not make use of the means provided for their protection.

There is necessity for an active campaign of education not only among the workers, but also among employers so that the danger and the remedies may become familiar to both.

Recommendations.

In the industries, a general law or regulation is not always practical, or capable of enforcement, for what may be just in one case would be unjust in another. It is recommended that the Labor Department be given authority to formulate special regulations for special industries using lead, modeled after the regula-

tions adopted by Great Britain and Germany. The Department should also possess the power to add to such rules new sections as may be required by changes in the industries or processes of manufacture.

The following industries are among those for which special rules should be formulated:

Manufacture of white lead.
Manufacture of dry colors.
Manufacture of lead oxides.
Manufacture of paints and varnish.
Manufacture of storage batteries.
Potteries and china makers.
Smelting, making of alloys and plumbers' supplies.
Manufacture of articles from metallic lead.
Manufacture of rubber goods where lead is used.
Painting of manufactured articles.

The following recommended regulations are merely general in character:

No female, or male minor under eighteen, should be permitted to handle any lead compound in dry or powdered form, or be employed in any process where dust containing lead compounds may be generated during the manufacturing process.

No worker should be employed in using lead without the possession of a medical certificate, and should have a periodical examination, at least once in six months.

Where large quantities of lead are used, the firm should have regular medical supervision.

Respirators, gloves, overalls and headcoverings should be furnished the workers, and the same cleansed or renewed at least once a week.

A dry room free from dust should be provided where the worker may hang such clothing as is not worn while at work. There should also be provided a separate place for keeping respirators, overalls and headcoverings used while at work.

Washing facilities consisting of hot and cold water, soap, nail brushes, and individual towels, should be furnished. There should be at least one tap or basin for every 5 workers.

No food or drink should be brought into any room where lead is used, and a special lunch room should be provided for the workers. Workers in lead should have a light warm meal before starting work in the morning.

The use of tobacco in any form should be prohibited during working hours.

All dust, fumes, gases or vapors created, should be removed effectively at the point of origin, and in a direction away from the worker. This is best accomplished by an exhaust system.

When a worker is found suffering from plumbism, he or she should be provided with employment where no lead is used.

Notices shall be posted warning of the danger from the use of lead, and giving rules for prophylaxis. This should be printed in several languages.

A record should be kept of all cases of illness, the record book to be readily available for inspection by officers of the Labor Department.

Time should be given the workers to wash up in, and at least one hour should be allowed for meals.

All workrooms should be thoroughly cleaned up by a wet process at least once a day, and, where the dust is hard to handle, should be dampened down several times during the day.

In order to prevent plumbism, it is necessary for the worker to realize that he or she must obey certain necessary rules of hygiene, otherwise regulations merely obeyed by the industries are entirely in vain.

Workers should realize that cleanliness is all important, and use should be made of the facilities furnished.

No food or drink should be brought into the factory, and no meals should be eaten in any room but the lunch room. Tobacco in any form should not be used during working hours.

The measures supplied for protection during work should be used and taken care of, and no apparatus for removal of dust or fumes should be interfered with or rendered useless.

Workers should submit to proper medical examination, and upon the first sign of illness, report at once to the physician.

Workers suffering from plumbism should not return to any work which exposes them still further to lead.

Care should be taken by workers so that other workers may not be exposed to the danger of poisoning through their carelessness in handling material, or in matters of personal hygiene.

ARSENIC POISONING.

Arsenic, meaning literally male arsen (from the notion of the alchemists that metals were of different sexes), was known to the early Greeks. Aristotle gave it the name of "sandaraka," and Theophrastus mentions it as "arsenikon." These substances were undoubtedly sulphides of arsenic. Olympiodorus, a Greek alchemist, obtained the oxide or white arsenic by roasting arsenic sulphide, and in the arts of the ancients these substances were used to impart a white color to copper.

Arsenic is found as an impurity with many of the minerals, but the more common ores are realgar, orpiment, arsenic pyrites or mispickel, and arsenolite. No arsenic is mined in the United States. Some 6,000,000 pounds of arsenic are imported annually, mainly from England and Germany.

CHEMISTRY.

Arsenic is a brittle, steel gray solid; upon being freshly broken it has a metallic lustre which disappears slowly in a moist atmosphere. Heated in the air it volatilizes without melting at temperatures above 212° F.— 100° C., and rapidly vaporizes at a dull red heat. The vapor is of a golden yellow color and has an odor of garlic.

There are many compounds of arsenic, but in the industries it is necessary to notice the following:

Arsenious oxide or arsenic trioxide is the most important, and is often called "arsenic" or "white arsenic." There are two common varities, a white, granular powder and an amorphous, glass-like solid. It has no odor, but has a faint metallic taste.

Scheele's green or Paris green, is a hydrocupric arsenite, containing 52.8% of arsenius anhydride.

Schweinfurt green, Vienna green, emerald green, is a cupric arsenite and acetate, containing 58.4% of arsenious acid.

Orpiment, or Arsenic trisulphide, contains 60.98% arsenic, is crystalline, and of a brilliant color. For industrial purposes it is

prepared artificially by subliming one part of sulphur with two parts of arsenic trioxide. The resulting product varies in color from yellow to red according to the relative quantities of the ingredients used.

Realgar, arsenic sulphide, contains 70.01% of arsenic. The commercial product averages 75% of arsenic.

Realgar is found native in ruby red crystals, and is also found at times associated with lead. It is prepared artificially for the industries by heating together nine parts of arsenic and four parts of sulphur, or, one hundred and ninety-eight parts of arsenious anhydride with one hundred and twelve parts of sulphur.

Arseniuretted hydrogen, arsine, is a colorless inflammable gas of fetid, garlicky odor. One litre contains 95.69% arsenic. Oxygen or air and arseniuretted hydrogen, make an explosive mixture. Chlorine decomposes the gas with great energy, combining with the hydrogen and setting free arsenic as a brown cloud, any excess of the chlorine combines with the arsenic as a chloride.

For many years the ordinary and best known qualitative test for ansenic has been the simple one known as Marsh's test, but, as antimony gives the same result as arsenic, the test is not reliable unless carried out very finely.

In atmospheric analyses where minute quantities of arsenic may be present, and a quantitative analyses is necessary, it is of importance that the method adopted be of extreme accuracy. In this conection the following method was pursued:

In all cases one thousand litres of air was aspirated through a battery of specially constructed gas-wash bottles, containing doubly distilled water. After securing the sample, nitric acid and sulphuric acid are added to the water to convert into a soluble form such arsenic as may be present. The solution is then evaporated until fumes of sulphuric acid come off. The mass is now transferred to a small florence flask which has a tube bent at double right angles leading into a high gas-wash bottle containing distilled water. To the contents of the flask is added one gram of ferrous sulphate. Heat is applied to the flask and hydrochloric acid run in. The acid is run in through a thistle-tube fitted with a stop cock. Chloride of arsenic forms in the presence of arsenic, which is soluble in the water contained in the gas-wash bottles. After completing the operation of the formation of arsenic

chloride, and no more will distill, the gaseous residue remaining in the apparatus is aspirated through a watery solution. In order to guard against outside atmospheric contamination and prevent collapse of the flask with a liability of sucking back of the liquid into the flask, a small check valve was placed on the flask. The chloride of arsenic collected in the large gas-wash bottle is now treated with sulphuretted hydrogen and a stream of carbon dioxide passed through the solution to dispel any sulphuretted hydrogen which may remain in excess. The resulting precipitate of arsenic sulphide is now collected upon an accurately weighed filter paper, and the result calculated.

In the analyses of dust, solutions and materials, use was made of the many accurate methods described in the textbooks on chemistry, those in Prescott and Johnson being given preference.

Toxicology.

Blyth, an eminent English authority, in an early edition of his work on poisons, states that "arsenic causes so many deaths both in man and cattle, that it comes under the notice of the chemist more frequently than any other poison."

In the list of industrial poisons prepared by a Committee for the International Association for Labor Legislation the following preparations of arsenic are found:

Arsenic, white arsenic, arsenious acid.

Arsenic acid. Arseniuretted hydrogen.

Orpiment. Realgar or Ruby sulphur.

Cochineal or Vienna Red.

Aceto-arsenite of copper (Schweinfurt, Vienna, or Emerald green).

Arsenite of copper (Scheele's green or Paris green).

Of these, white arsenic and arseniuretted hydrogen are extremely dangerous. Small doses, as 2 or 3 grains of the white arsenic, being oftentimes fatal.

Absorption of the poison into the system may occur in one of the following ways:

Through the alimentary canal (stomach and intestines).

Through the respiratory tract (lungs, etc.).

Through the mucous membranes of the nose and throat.

Through the skin.

In considering arsenic poisoning generally, we may do so under three forms: Acute, chronic, and a form limited to purely local lesions.

In acute arsenical poisoning, such as results from accident, suicide, or homicide, the arsenic enters the system through the alimentary tract, but in cases of industrial poisoning this occurs only where the workers take their meals into workrooms containing quantities of arsenic, especially in the form of dust, or fail to wash their hands and face properly, either before eating, or upon completing the day's work and leaving for home.

In acute poisoning the following symptoms usually occur within a short time after exposure:

Intense epigastric pain, a metallic taste in the mouth, and, at times, salivation. There is intense thirst, colic, diarrhoea, and suppression of urine, or bloody urine. The heart action is feeble, and there may be palpitation. There may be cough and oppressed breathing, oedema (swelling) of the eyelids or general oedema. Some cases exhibit no gastro-intestinal symptoms, but suffer a sudden collapse, passing into a coma resembling a narcotic poisoning, or exhibit symptoms resembling cholera.

Arsenic may be gradually absorbed into the system in very small quantities covering a long space of time, and is capable of being stored in the body, especially in the tissues of the brain, spinal cord and the liver, resulting in chronic arsenic poisoning, the poison as a rule entering the system through the respiratory tract and mucous membranes as a result of exposure to arsenic dust or fumes.

The usual symptoms of chronic arsenic poisoning are debility, anaemia, and urticaria (skin rash). There may be diarrhoea, or a mucous discharge from the bowels which is considered by Dr. Lloyd as a significant sign. There may be redness or even bleeding from the gums. Multiple neuritis and paralysis may often develop as a later result, resembling to a great extent the results of lead poisoning. Where the individual is exposed to the effects of both lead and arsenic there is liability of a wrong diagnosis. The following are points for differential diagnosis:

Lead. Paralysis confined to the extensor muscles of the wrist and first phalanges. Pure motor paralysis is seldom present. Sensory disturbances are slight or usually absent.

Arsenic. Paralysis may attack wrist, more often involves the corresponding muscular groups of the lower extremities, and often involves the muscles of the thigh and upper arm. Pure motor paralysis is always present. Sensory disturbances are marked. Rapid wasting occurs and the atrophied muscles present the reaction of degeneration. At times the extensor and peroneal muscles are involved causing a gait termed by Dr. Butler, "the steppage gait." In arsenical poisoning there is oftentimes a fine tremor present resembling that caused by lead, mercury and alcohol. The local form results as a rule from the action of dust containing arsenic upon the skin and mucous membranes. In the presence of moisture the arsenical compounds are very irritating and possess caustic properties. The points of attack are usually the hands, forehead, neck and genitals, parts of the body usually moist from perspiration.

The lesions usually appear with greatest severity upon the hands, as those members are constantly wet from contact with solutions, and come in closer contact with the toxic material through continual handling.

In the nose the mucous membrane becomes highly inflamed, there is excessive coryza. In serious cases there is a perforation of the septum (the cartilage partition between the nostrils), and termed rhinitis perforans.

The local lesion may first appear as a slight eczema, the eruption soon becoming pustular, and if neglected are very apt to develop into painful ulcers.

Many dermatologists (Kirchgasser, Lepine, Beaugrand) have described a brown pigmentation of the skin as typical of arsenic poisoning. Sir Thomas Oliver calls attention to the fact that arsenic has the effect in some people of predisposing to cancer. Hutchinson believes that its absorption in the system over a long period may cause epithelioma.

Arsenic is eliminated rapidly through the kidneys and the skin, but is attended with marked irritation, as is manifested by nephritis (kidney disease) and skin eruptions.

It has been demonstrated by Prof. Brouardel that the milk of nursing mothers will absorb arsenic that may be in the system, and that it may take as long as forty days to eliminate one dose.

Prof. White states that arsenic passes from the mother to the foetus. This would indicate that a grave danger exists both to mother and child in exposing women to the effect of arsenic.

At the International Congress of Hygiene held in Paris in 1880, a report on arsenic poisoning in the trades was presented by Gubler and Napias. In the report was a tabulation of industries using arsenic in some form, and are as follows:

Workers on lead frames.
Workers on colored paper.
Color grinders.
Foundry workers.
Wire drawers.
Printers.
Paper glazers.
Paper cutters.
Makers of velvet.
Cloth dressers.
Dyers.
Cloth printers.
Painters (outdoor).
Color makers.
Painters and decorators.
Artificial flower makers.
Artificial foliage makers.
Makers of green lamp shades.
Leather curriers.
Dressmakers.
Aniline workers.
Smelters of mineral arsenic.
Makers of arsenious acid.

In 1892 Dr. Layet of Paris prepared the following table of 27 trades or professions wherein the workers were exposed to the danger of arsenic poisoning:

Workers employed in the preparation of arsenic and arsenious acid.

Workers employed in the smelting of tin and pewter.

Workers employed in the smelting of cobalt.

Founders of copper.
Founders of zinc.
Workers in the aniline industry.
Manufacture of iron sulphate by the action of sulphuric acid on old iron.
Chemists.
Arsenical color works.
Manufacture of colored paper.
Manufacture of artificial leaves and foliage.
Aeronauts.
Inflaters of toy balloons.
Bronzers of metal.
Manufacture of vault lights (glass).
Colorers and curriers of leather.
Tinters and dressers of cloth.
Tanners.
Taxidermists.
Manufacture of artificial stones.
Jewellers.
Manufacture of glass and crystal.
Drawing of zinc wire.
Hatters.
Manufacture of colored crayons.
Manufacture of artificial soda (salt wort).
Manufacture of glucose.

Reference to the numerous works on industrial diseases, industrial hygiene, forensic (legal) medicine, and chemistry, shows the following occupations listed under those wherein there is danger to the worker from arsenic poisoning:

Furriers.
Manufacture of candles and wax ornaments.
Manufacture of japanned goods.
Manufacture of carpets.
Fancy bookbinding.
Preservation of wood.
Manufacture of gloves.
Manufacture of sheep dip.
Electroplating.

Lithographing and bronzing.
Manufacture of artificial leather.
Manufacture of oilcloth and linoleum.
Manufacture of cut glass.
Manufacture of hat linings.
Manufacture of beer.
Soaking of silk cocoon.
Enamelling.

This presents rather a large list of occupations and would seem to confirm the statement of Blyth's. Notwithstanding the danger from arsenic poisoning in the industries, the literature on the subject is rather meagre, and the special investigations undertaken are rather disappointing in their reports. A splendid report is that of the Commission appointed by the Department of Commerce and Industries of France, but it is over twenty years since they completed their labors.

Processes of manufacture have, since then, undergone successive changes, due to improvement in machinery, and the advancement made in the science of industrial chemistry, whereby harmless substitutes have replaced the arsenic preparations.

In the report of Dr. Legge (H. M. Medical Inspector of Factories in Great Britian) for 1900, there are reported seven cases of poisoning in color works, and thirteen cases from arseniuretted hydrogen, while in his report for 1910, there are only reported two cases in color works, and two cases in arsenic refining.

During the first year of reporting in this State there were reported two cases in color workers, one case in paint works, and one case in a tanner.

This would indicate that the danger is limited to a very few industries, but in order to secure confirmatory proof, an endeavor was made to get at least some information in regards to the occupations mentioned in the foregoing tables.

The folowing cases of arsenic poisoning cited by various observers are of interest, and emphasizes the need for intensive investigations of industries for the purpose of discovering the use of poisonous materials:

Blyth reports a case of poisoning from inhaling the fumes from arsenical candles.

Sajou cites (from the N. Y. Medical Record, March 30, 1889) cases of arsenical poisoning in children attending a Christmas party. The symptoms were finally traced to the burning of candles containing Scheele's green.

Inquiries were pursued into this subject, and it was ascertained that arsenic was not used in candles, the aniline colors and chromes (lead) being used. Some colored candles were secured and analyzed, but no arsenic was found.

Hehne reports the occurrence of arsenic poisoning among a number of workers in an English brewery, and the symptoms were traced to the use of glucose made with contaminated sulphuric acid. Dr. Reynolds of Manchester found as high as 2.6% of arsenic in the acid, and as high as four grains per pound in the glucose. Analyses of the beer showed a large percentage of arsenic, and it estimated that 6,000 persons suffered poisoning, 70 with fatal results. It was also found that the malt dried in English malt kilns was contaminated with arsenic, resulting from the use of coal. It is asserted that all coal contains pyrites, and this mineral is again contaminated with arsenic. Glucose, it must be remembered, is used in the manufacture of a large number of food products.

During our investigation we were unfortunately unable to study this subject.

Dr. Legge reports the following cases:

A worker engaged in putting copper tubes in a muffle furnace.

A case of arseniuretted hydrogen occurring in a worker employed at galvanizing iron.

A number of cases in chemical works.

Several cases in a copper recovering plant.

A case of a mixer of dehairing solution in a tannery.

The following extract is from an article by Murrell and Hale, British Medical Journal, July 11, 1896:

A preliminary report as to the presence of arsenic in cigarette wrappers: Out of seventeen series of different kinds of cigarettes and tobacco, arsenic was present in the labels of six, or more than a third. The arsenic in these cases was present in such large quantities that no difficulty was experienced in demonstrating the fact. Suggestion that, as the inhalation of arseni-

ous acid, even in minute quantities for a considerable time produces cough, haemoptysis, expectoration and loss of flesh, which are readily mistaken for phthisis, the advantage of accurate knowledge concerning this subject is most apparent.

The cigarette paper of six brands manufactured in this State were analyzed and no arsenic found, but this investigation was not sufficiently extensive to render a definite decision.

Murrell states that arsenic is used in the binding of books, and that the dust which collects on the top of bookcases in libraries contains considerable quantities of arsenic.

Inquiries among bookbinders failed to confirm this statement, and analyses of a number of samples of dust taken from the books and bookcases in the chemical library of the University of Rochester failed to show any arsenic present.

Industries.

In pursuing the investigation, the industries were grouped under the following headings:

Industries wherein arsenic or compounds of arsenic are manufactured.

Industries wherein arsenic or preparations or arsenic are used in the process of manufacturing processes.

Industries wherein materials liable to be contaminated with arsenic are manufactured or used.

In many of the industries visited both lead and arsenic were reputed to be used, therefore the description of the plant has been incorporated in the report on lead poisoning.

There are a number of industries wherein arsenic is used, which are located in Greater New York, the same type of industry not being found in any other portion of the State, so that, while not included in the investigation, still it is deemed advisable to make some reference to them.

The following are industries visited wherein it is reputed that arsenic poisoning may occur:

Industries Wherein Arsenic and Its Compounds are Manufactured.

The mining or extraction of arsenic is not carried on in this State, and the conclusions of the French Commission on Indus-

trial Poisons were, that poisoning among workers engaged in handling minerals containing arsenic, or engaged in extracting it, were rare. I was informed by the former manager of a large lead mine in the West, that a number of cases of mixed poisoning (lead and arsenic) occurring among the miners had come under the observation of the company doctor.

Arsenic Colors:

There is but one plant outside of Greater New York engaged in this process, and at the time of our visit no work was being carried on in this portion of the plant. The factory is a small one situated in a small village near the river, the products are paints, vermin exterminator for plants and arsenic greens. In the vermin exterminator, two per cent arsenious acid is used.

The building used for the arsenic color is about fifty feet square, and consists of two stories. Five males are employed. The first floor is devoted to manufacturing, bolting and packing. No means are in use for dust extraction, and no respirators are furnished or worn. The second floor is devoted to the mixing mills and is very dusty. No provision is made for keeping down the dust or exhausting it. No samples were taken for analyses as the arsenic processes were not in operation.

One worker was examined, he had been employed for thirty-two years and showed no symptoms, and gave no history of ever having had arsenic poisoning.

Workers in arsenic color are extremely liable to arsenic poisoning, exhibiting itself in skin eruptions, especially upon the hands, termed, "arsenic pock," and by some French writers as "rossignol," or "Cholera des doigts." During visits paid to the color works located in Greater New York the cases of poisoning seen by me showed a rash on both the hands and face. The irritant action of arsenic dust was fully demonstrated in the case of Inspector Vogt and myself. After spending several days exposed to the dust, the mucous membranes of our noses were inflamed for some time afterwards. An analysis of air from one of the packing rooms showed .303 Grams of paris green per cubic

meter of air, and further analyses showed that of this, .093 Grams was arsenic.

Dr. Collis reports the finding of several cases of perforation of the septum of the nose, this I have not seen, and Dr. Legge also reports that he has not seen such cases.

In this industry the danger is from the dust, especially in the processes of drying, bolting and packing.

Aniline Works:

There is but one aniline works outside of Greater New York, and is situated in the open near the river. Upon inquiry it was ascertained that arsenic had not been used for many years, and both the manager and chief chemist rendered every assistance to prove the truth of the statement.

By some writers it was reputed that the danger existed in the preparation of rosaniline. This could not be verified.

Industries Wherein Arsenic or Preparations of Arsenic are Used.

Colored and Glazed Papers:

Three large factories of this industry were visited, all were located in the open country, and, owing to the necessity of large space for drying purposes, the air space in proportion to the number of workers was enormous.

In this industry the danger was reputed to be due to the use of arsenic colors. Samples of the ingredients used were obtained and analyzed, but no arsenic was found. None of the workers examined showed any symptoms, and no histories could be obtained of any illness among the workers resembling arsenic poisoning. The superintendent of one factory, a Frenchman of many years' experience, informed me that many years ago arsenic poisoning did occur among the workers in this industry, but that within the last fifteen years the only ingredients used are aniline colors, barium, caseine and clay. The firm very kindly permitted us to examine book of supplies purchased, and this, together with the result of our analyses, confirmed the fact of no arsenic being used.

Paint Works:

Six paint factories were visited, three used arsenic colors but to a limited extent, the principal output being lead colors. At the time of the visits arsenic was not being used. No cases of poisoning were found among the workers, and all information as to whether there had ever been any cases was negative.

That there is danger cannot be doubted, for the reports of other countries, and the report of one case to the Department demonstrates the fact. The process wherein the danger lies is from the dust created in handling the dry arsenic color. In this industry there is danger of mixed poisoning, and the industry is described at greater length in the report on lead poisoning.

Rubber Goods:

Five plants were visited where rubber was used, in but one was arsenic used. This was a large plant situated in the open country, and manufacturing rubber goods exclusively. Very small quantities of arsenic were used, and that at great intervals for coloring purposes. At the time of our visit none was being used. The workers liable to poisoning were those engaged in compounding and at the mixing rolls. No cases of poisoning were found, and none were reported. Samples of ingredients being used at the time of our visit, as well as of the finished product, were secured and analyzed. No arsenic was found. A further description of the plant is included in the lead report.

Manufacture of Glass:

The French Commission reports that in the manufacture of glass, upon putting the mixture in the furnace a portion of the arsenious acid volatilized, and its odor was very appreciable. They cite the investigations of Boedker de Witten, made in 1862, which showed that only one-fifth of the arsenic remained in the mixture, four-fifths volatilizing, with the result that the fumes in the chimneys contained considerable arsenic. A further analysis of the fumes showed 0.425p.100 arsenious acid. The Commission finds that the danger is greater from the dust.

Six glass factories were visited, of these, two used arsenic for the purpose of producing a white or milky-colored glass. One factory visited is reputed to be one of the largest glass factories in the world. At this plant white arsenic is used in the proportion of one-half pound of arsenic to every twelve hundred and fifty pounds of other ingredients. In the process of mixing and of placing mixture in the furnaces, no conditions were observed as reported by the French Commission, but this may have been due to the result of modern methods in use at the plant.

The danger exists in the mixing room, due to the handling of the dry arsenic which is shoveled into the open mixing trough. The amount of arsenic placed in each batch is very small, and the total amount used during the year is only a few hundred pounds. The greatest danger is from lead poisoning, and for that reason the industry is considered more fully in the report on lead poisoning.

Analyses of samples of air taken during mixing, and in the furnace rooms failed to show the presence of arsenic.

As the workers who are directly exposed to the danger of poisoning were foreigners who understood very little English, it was difficult to obtain much information as to illness. None of the men exhibited any symptoms of arsenic poisoning, and it was asserted that there had never been any cases previously.

At the second plant visited, no mixing was being done at the time of our visit, and it was stated that no arsenic glass was being worked just then.

Samples of air were secured from the furnace room and the analyses failed to show any arsenic present. No cases of arsenic poisoning were found, and none were reported.

Electroplating:

Five plants were visited where electroplating was carried on extensively. It was ascertained that white arsenic was formerly used for the production of French gray (a form of oxidizing), bronzing and brass plating, but at present it was not used owing to improved methods. The opinions of the head platers inter-

viewed were all to the effect that the use of arsenic was unnecessary, and that they did not use it.

We were permitted to examine the list of supplies purchased and found no account of arsenic. Analyses of the solutions in use failed to show the presence of arsenic, and an examination of the workers failed to show any symptoms of poisoning. No cases were reported.

In two of the plants several assistant platers were questioned very closely, and they admitted that if over rushed with work requiring brass plating, they surreptitiously used small quantities of arsenic which they purchased themselves. The proportion of arsenic used was two ounces to one hundred gallons of solution. The largest amount ever used in one year was one hundred pounds. This was reported by a very large concern where it had formerly been used in the production of grays.

Wall Paper:

Poisoning from wall paper has been the subject of a great many writers and the cases cited are numerous. In the past many noted investigators have proven that danger did exist.

It was asserted that the action of certain moulds upon the arsenical organic matter in wall paper produced a volatile oil which rendered poisoning through the lungs possible.

One wall paper factory was visited, and it was ascertained that aniline colors alone were used, arsenic colors having been dispensed with as a result of the many cases of poisoning reported and its effect upon the sale of wall paper. No cases of poisoning among the workers were reported. Several samples of wall paper were analyzed but no arsenic was found.

Hayward and Warner report that of 537 samples of wall paper examined, 75% contained more than 0.1 grain of arsenic per square yard. Two of the samples came from England. Five samples contained less than 0.1 grain. Two were from England, one from France and one from Germany. Ninety per cent of the samples contained less than .046 grains per square yard.

Dr. Legge cites a case of poisoning from wall paper. An analysis of the paper showed it to contain ".004 of a milligram

of arsenic per gram of paper. Clean unused white foolscap paper has been found to yield a very higher proportion of arsenic."

This tends to show that at the present time, very little danger from poisoning exists in the wall paper industry.

Japanning:

This is a variety of varnishing used on leather, but mostly for cheap household utensils.

Three large plants were visited where japanning was carried on extensively. It was ascertained that at one time the arsenic colors were used in small quantities for producing delicate opaque colors, but had now been discarded. Analyses of the solutions used showed no traces of arsenic, and no cases of poisoning among the workers could be found.

Enamelled Ware:

One large plant making high grade enamelled ware for household purposes was visited. Analyses of ingredients used showed no arsenic to be present.

Dyeing, etc.:

Various writers have reported cases of poisoning from yarns and cloth goods as a result of using arsenic as a mordant.

In a case of reputed poisoning from embroidery yarn, Dr. Legge had Dr. Thorpe analyze several shades of green worsted used. Dr. Thorpe reported the yarns practically free from arsenic.

Two large woolen mills were visited, and the head dyers stated that arsenic was not used. Analyses of the dyeing solutions failed to show arsenic present.

One large carpet factory was visited. It was stated that only aniline colors were used, and that they used no preparation of arsenic. Analyses of solutions used failed to detect any arsenic.

One large plant was visited where plush and upholstery trimmings were manufactured. It was claimed only aniline colors were used. No arsenic was found in the dyes.

In none of these industries could any cases of arsenical poisoning be found, nor has any ever been called to my attention.

Artificial Leather. Oilcloth:

One large plant was visited where artificial leather was manufactured. It was admitted that arsenic colors (greens) were used, but in small quantities and at great intervals. At the time of our visit no material requiring the use of arsenic was being manufactured.

The danger is confined to the color mixing room. Here the workers handle the dry colors and are liable to poisoning through inhalation of the dust created.

No cases of arsenic poisoning were found among the workers, and there was no history of any poisoning among the workers at any time.

One large oilcloth plant was visited. The manager stated that no arsenic colors were used. No cases of arsenic poisoning were found, and no arsenic was found in the colors used.

Artificial Flowers and Foliage:

The danger in this industry was reputed to be from the use of the arsenic greens for the purpose of dyeing and dusting the material.

A number of factories were visited. It was stated that for many years past nothing but aniline colors had been used. A number of samples were secured, which upon being analyzed failed to show any traces of arsenic.

Tanning of Leather:

Dr. James G. Parker, an English authority on leather, states that in the process of tanning, realgar (arsenic sulphide) is used for the purpose of depilation (removing of hair from the hide). The realgar is slaked with the lime, and is used in the production of the finer light leather, such as glace kid and glove kid. This method produces a very smooth grain (the use of sodium sulphide tends to make the grain harsh and bold) and is, therefore, very suitable for the purpose, but it is very expensive.

In 1895 "Le Comite consultatif d'hygiene publique de France" reported that the solution for fine leathers contained 4 to 10 Kilos of orpiment to 400 Kilos of lime and 20 Hectolitres

of water. The irritant action of the orpiment resulted in "le cholera des doigts" (a skin affection of the fingers, resulting in painful ulcers). They further reported that there was danger in the handling of skins preserved by means of a solution of arsenious acid and sodium carbonate, these skins coming principally from Australia, Tasmania, New Zealand and the Platte.

Blyth states that tanners formerly employed a mixture of ninety parts orpiment and ten of quicklime, under the name of "Rusma," but the alkaline sulphides from gas works have replaced it.

Three large tanneries were visited. The head of one of the plants, a tanner of many years' experience and an authority on tanning, stated that for a great many years past, arsenic had not been used, as lime was much cheaper for the purpose of dehairing; besides, improved dehairing machinery had rendered the use of arsenic unnecessary. These statements were confined by all the tanners visited. Samples of the solution used in each plant were taken and analyzed. The results of the analyses showed no arsenic present.

A case of arsenic poisoning in a tanner was reported from a hospital in Greater New York, but upon investigation the patient could not be found, and the tannery where he worked had not been given.

From the results of our investigation, I am rather of the opinion that the case was not a true arsenic poisoning.

Taxidermy:

This art is limited to a few isolated individuals, and to the public museums of natural history, or in connection with college or university museums. While the workshops of taxidermists are not inspected by the Department, it was deemed advisable to include the subject in the investigation.

The danger in taxidermy is from the use of white arsenic. This is incorporated in the preserving soap, and consists usually of 40% white arsenic. The white arsenic is also used as a dusting powder on the inside of the specimen before stuffing.

Montagu Browne, an English authority, states that an efficient substitute may be used, consisting of soap, whiting, chloride of lime and musk.

Mr. Donovan, of the American Museum of Natural History, informed me that an alum mixture may be used in place of the arsenic powder. He stated that in his fifteen years' experience with arsenic he had never been poisoned, nor had he known of any cases, though in the hands of unskilled workers there is a danger.

Several taxidermists were visited and all admitted using arsenic, but denied ever having been poisoned. No cases have so far been brought to my attention.

Furriers:

Haywood and Warner report having examined 47 samples of fur to be used as articles of dress, of which 11 samples contained from 20 to 1,700 times as much arsenic as would be allowed by the Massachusetts laws, which limits the amount to .10 grains per square yard in papers and woven fabrics, and .01 grain per square yard in dress goods and articles of dress. It is presumed that this amount is added during the process of preparing the fur.

This subject was investigated shortly before undertaking the present investigation, and a full account will be found in the report of the Commissioner of Labor for the year 1912. The results of the investigation do not confirm the findings of Hayward and Warner, as no arsenic was found in any of the samples analyzed.

A number of furriers were visited during the course of the present investigation and they denied using any arsenic, stating that it was liable to ruin the fur.

No cases of poisoning were found among the fur workers, nor have any cases been brought to my notice.

Bronzing and Lithographing:

Dr. Collis, in a special report on bronzing, states that "bronzing powders consist of copper, zinc and aluminum, with small and negligible traces of tin, lead, arsenic and iron. Of ten sam-

ples of gold and bronze powder analyzed six contained slight traces of arsenic. Three silver and aluminum powders contained no arsenic, and six colored powders contained no arsenic, but did contain coal tar dyes. The analyses were made by Dr. Thorpe and Mr. Hooper of the Government Laboratory.

The question of arsenic poisoning is not discussed in the report, and the conclusions would seem to indicate that danger from arsenic poisoning does not exist.

Two large plants were visited and the bronzing departments carefully investigated. No cases of arsenic poisoning were found, and none were known of. Analyses made of a number of samples of bronzing powder failed to show the slightest trace of arsenic present.

Lithographing:

The danger in this process is reputed to result from the use of arsenic colors.

Two large plants were visited, no symptoms of arsenic poisoning were found among the workers, and analyses of the colors used failed to show the presence of arsenic.

In one plant a sample of the water in which the color mixer had washed his hands, after the morning's work, was carefully analyzed for traces of arsenic, but none was found.

These results tend to confirm the findings of the British investigation as to the absence of danger from arsenic poisoning in the processes of bronzing and lithographing.

Colored Crayons:

No factories were visited where crayons were made, but it was ascertained through inquiries that aniline colors alone were used. A number of colored crayons were secured and analyzed. In none of them was the slightest trace of arsenic found.

Industries Wherein Materials Liable to be Contaminated With Arsenic are Manufactured or Used.

Chemical Works:

In this industry Dr. Legge reports a number of cases poisoned through arseniuretted hydrogen gas, and attributes it to the use of impure acids. Several of the cases were fatal.

Visits were made to two chemical plants but little information could be obtained. It was denied that any cases of poisoning had occurred, and it was impossible to obtain any samples for analyses.

One plant manufacturing sulphuric acid was visited. At the time of the visit there was a leak in one of the pipes leading from the still, so the air was heavily charged with acid fumes. Analyses failed to show any arsenic present, and no cases of poisoning could be found, inquiries failed to show that the workers had ever shown any symptoms attributable to arsenic.

Copper and Brass Foundries:

In these industries the danger is attributed to the presence of arsenic in the copper used. During the process of melting the copper, fumes of arseniuretted hydrogen are generated. The workers most exposed to this danger are the casters or furnace tenders.

Three large copper plants and six plants with brass foundries were visited. Careful examination failed to show that any of the workers had suffered from arsenic poisoning. Samples were secured during the time of pouring off, and also from the fumes in the pots, but no traces of arsenic were discovered. This does not, however, prove that there is no danger, and in my opinion a much more intensive and wider investigation should be undertaken before rendering any decision.

Galvanizing:

In this industry the danger is attributed to the fumes of arseniuretted hydrogen due to the use of impure acid and zinc.

Four plants were visited. Analyses of the fumes from the galvanizing pots showed no arsenic present. Analyses of the hydrochloric acid used also failed to show any arsenic impurity present.

The majority of the help were all foreigners who understood very little English, and were not long at the work. Thus it was impossible to secure any definite information as to poisoning. While the results of our investigation would seem to indicate that no danger from arsenic poisoning exists, it is not conclusive, as at some time or other, despite all precautions, an impure acid might be used with fatal results.

Conclusions.

The results of the investigation may be summarized as follows:

Arsenic and its compounds are powerful poisons, and their use in the industries is attended with danger to the health of workers exposed to them.

Poisoning may occur accidently through the use of material which, unknown to the worker, contains arsenic as an impurity.

Poisoning may occur through the handling of or exposure to the dust of arsenic or its compounds.

The form of poisoning most seen is that limited to local lesions of the exposed portions of the body (hands and face), and to the mucous membranes of the nose.

The greatest danger exists in industries devoted to the manufacture of Paris green and Vienna green.

Danger exists in the following industries: Paint works; plant vermim exterminator; glass works, other than bottle and window glass; artificial leather and oilcloth; electroplating; taxidermy; rubber goods, other than for insulating purposes.

In a number of industries there is danger of a mixed poisoning, which is liable to render a proper diagnosis difficult.

The majority of the workers are unaware of the poisonous nature of the material handled, and where precautions are taken it is only because lead compounds are also used.

The danger can be minimized by the removal of the dust or fumes at the point of origin and in a direction away from the worker.

The danger may be obviated by the industry furnishing adequate facilities for cleanliness, and by the workers making use of the facilities and observing proper rules for personal hygiene.

A periodical physical examination should be made of workers employed in handling arsenic or its compounds.

Recommendations.

The prophylaxis of arsenic poisoning rests as much with the worker as with the proprietors of the industry.

In all factories where arsenic is used, or where there is danger of accidental poisoning, there should be kept on hand, and in an

accessible place, the ingredients for freshly preparing the arsenic antidote, ferric hydroxide.

General Regulations for Employers where Arsenic or its Compounds are Used:

No female or male minor under 18 years of age shall be employed in handling arsenic and its compounds, or in any occupation where they may be exposed to dust, fumes or vapors containing arsenic or its compounds.

There shall be provided proper washing facilities with a sufficient supply of hot and cold water, soap, nail brushes and towels (individual).

Where dust is created, as in the processes of dusting, grinding, sieving, mixing or brushing, respirators, overalls and head coverings shall be provided, and kept in a cleanly condition. It shall be incumbent upon the proprietor to see that they are used.

Where dust, fumes, gases or vapors are generated as a result of handling material, or during the process of manufacture, means shall be supplied to remove same completely at the point of origin, and in a direction away from the worker.

No article of food or drink shall be permitted to be brought into any room where arsenic or its compounds are used, and no worker shall be permitted to partake of any food or drink in such room.

No worker shall be employed without a certificate from a physician as to physical fitness, and the worker shall be examined at least once in six months.

No worker who has been absent through illness shall be permitted to return to work without a physician's certificate to the effect that he is physically fit.

If a worker who has been in contact with arsenic complains of feeling ill, the employer shall have him examined by a physician, to determine if there is poisoning.

The use of smoking or chewing tobacco during the hours of labor shall be prohibited.

A place free from dust shall be provided for the purpose of the worker keeping such clothes as are not required during his work.

Regulations for Employees:

Workers should make use of the washing facilities and wash up thoroughly before eating any meals, or before leaving for home.

No food or drink should be brought into any room where arsenic or its compounds are used, and no food should be eaten there. Tobacco should not be used in any form while at work.

Respirators, overalls and head coverings should be worn while at work, and discarded before eating meals or leaving for home.

No worker shall interfere with the means provided for ventilation, or the removal of dust, fumes, gases or vapors.

If ill, report at once to the person in charge for examination by the firm's physician.

Regulations where Arsenic Impurities may Exist:

Where acids, which may contain arsenic impurities, are used in large quantities, the acid shall be tested before use, and if found to contain impurities, the workers shall be warned, and provisions made to safeguard them.

In chemical works where workers are required to enter tanks, chambers, or confined spaces, containing ingredients liable to contain arsenic impurities, provisions shall be made for thoroughly ventilating such places, and for analyzing contents, and the worker shall not enter such tank, chamber, or confined space, unless no danger exists.

Where fumes liable to contain arsenic (through impurities of materials used) exist, mechanical means for general ventilation shall be installed, and means shall be provided for removing the fumes at point of origin.

Regulations for Color Works:

No compounds of arsenic shall be ground, sieved, mixed, or handled, except by means of, or in an apparatus completely enclosed so as to prevent the escape of dust, or where an efficient exhaust system is installed to remove the dust entirely at the point of origin.

Overalls, head coverings and respirators shall be furnished for all workers, and shall be washed or renewed once a week.

A room, dry and free from dust, shall be provided where the worker may leave such clothing as is not worn during his hours of work. A separate room shall be provided for keeping overalls, head coverings and respirators in.

Adequate washing facilities shall be provided, consisting of a sufficient supply of hot and cold water, soap, and individual towels and nail brushes.

No food or drink shall be permitted to be brought in to any portion of the factory excepting in such room as shall be set aside for that special purpose. No food or drink, or the use of tobacco in any form, shall be permitted in any portion of the factory excepting the lunch room.

Every factory shall employ a physician who shall examine all applicants for work, and re-examine all workers at least once every three months, suspending any worker showing symptoms of poisoning.

If absent through illness, no worker shall be re-employed without a physical examination by the physician.

All physical examinations and cases of illness shall be recorded in a special book for that purpose, the same to be accessible for inspection by the Labor Department.

A suitable room entirely separate from rooms where processes of manufacture are carried on, shall be set aside as a lunch room, and no worker shall be permitted the use of such room until after removing and leaving outside, overalls, head coverings and respirators, and has thoroughly washed up.

Regulations for Employees:

All workers upon feeling ill should report at once to the attending physician.

All workers should observe the rules of personal hygiene, as cleanliness is the best antidote, therefore, use should be made of the facilities provided for cleanliness. No meals should be partaken of before removing work clothes and thoroughly washing up.

No food or drink should be brought into, or partaken of, in any room of the factory excepting the lunch room. Tobacco should not be used in any form during working hours.

Workers should wear the overalls, head coverings and respirators provided, removing same, and depositing them in the place provided, before washing up, entering the lunch room, partaking of food, or leaving for home.

No apparatus or means for removing dust should be interfered with or rendered ineffective.

In conclusion it may be stated, that while the history of poisoning from arsenic would seem to indicate a condition of remarkable safeness in the industries, it must be remembered that the industries wherein the greatest danger lies have not been included in the investigation.

I would recommend that provision be made for a further intensive investigation into arsenical poisoning.

Respectfully submitted,

C. T. GRAHAM-ROGERS,
Medical Inspector of Factories.

FACTORIES VISITED WHER

Index.	Industry.	Employees.		Portion of plant visited.	Material used.	Ventilation.
		Male.	Female			
1	Reduction of metals.	14	0	Melting room.....	Metallic lead, 30 tons a year.	Natural doors ar windows; met pots hooded.
2	Special alloys.....	20	0	Melting room.....	Metallic lead, 50 tons a year.	Natural doors ar windows.
3	Plumbers' supplies...	8	0	Pipe and solder room.	Metallic lead, amount not given.	Natural doors ar windows; 2 le and 5 solder po hooded.
4	Pipe drawing.....	6	0	Pipe room.....	Metallic lead, 4-5 tons a day.	Natural doors ar windows; air pa dles driven l power; 2 lead po hooded.
5	Solder and Babbitt metal.	3	0	Solder casting room..	Metallic lead, 20 tons a year.	Natural doors, wi dows and louv roof; metal po under large hoo
6	Plumbers' supplies...	4	0	Lead pipe room.....	Metallic lead, 2 tons a day.	Natural doors ar windows; 2 le pots hooded.
		2	0	Solder room.....	.....	Natural; 1 lead p hooded.
7	Carborundum.....	76	0	Wheel dressing and finishing...	Metallic lead, amount not given.	Exhaust system grinders.
8	Firearms.....	5	...	Blacksmith shop....	Metallic lead, 150 lbs. a year.	Natural doors ar windows.
		2	14	Cartridge dept.....	Metallic lead, amount not given.	Natural doors ar windows.
9	Firearms.....	2	0	Machine shop.....	Metallic lead, 400 lbs. a year.	Vacuum system.
10	Cutlery.....	10	0	Blacksmith shop....	Metallic lead, amount, not given.	Exhaust fan over o large lead pot; le pots hooded.
11	Files and rasps.....	...	...	Blacksmith shop....	Metallic lead, amount not given.	Natural doors ar windows.
12	Brass goods.....	6	0	Casting room.....	Metallic lead, amount not given.	Natural windows ar Texas roof; 1 le pot, hooded.
13	Valves and hydrants.	40	0	Foundry.....	Metallic lead, amount not given.	Natural; hood ov crucibles.
		10	0	Hydrant dept.....	Metallic lead, and lead paint.	Natural.
14	Harness hardware...	...	...	Tinning room.....	Metallic lead,.....	Natural windows.
15	Brass and copper....	90	0	Casting room... ...	Metallic lead, amount not given.	Natural windows ar Texas roof louvr
				Casting room, East Mill.	Metallic lead, amount not given.	Place all open; Tex roof with louvr
16	Stamped ware.....	6	9	Soldering room.....	Metallic lead, amount not given.	Natural doors ar windows.
		3	0	Paint shop.....	Lead colors, amount not given.	Natural doors ar windows.
17	Automatic fire sprinkler.	5	0	Solder room.....	Metallic lead, amount not given.	Natural; 1 solder fu nace hooded.
18	Tin cans.....	40	10	Soldering room.....	Metallic lead, 900 lbs. a day.	Machines hooded exhaust.
19	Tin cans.....	5	0	Solder making.....	Metallic lead.....	Natural and 4 sold pots with exhau
		2	7	Hemming room.....	Metallic lead.....	Natural doors ar windows.
		30	0	Soldering room.....	Metallic lead, ½ ton a day.	Machines hooded ar piped.

LEAD OR ARSENIC WAS USED.

Air analysis.	Cases of Poisoning		Welfare.	Remarks.
	Lead.	Arsenic		
No lead present	1	...	Hot and cold water, soap towels and goggles furnished.	Dirt floor clean; 1 lead pot has no hood.
No tests, melting pots idle	0	...	Sink and cold water	2 lead pots, no hood; meals eaten in lead room.
lead present	2	...	Cold water, gloves furnished.	1 solder pot no hood; meals eaten in lead room; wood and brick floor untidy; gloves analyzed after 1 day's use .00610 grams lead; after 3 days' use 1.37 grams of lead.
lead present	0	...	Hot and cold water, soap and gloves furnished.	Wood floor; metal dross on floor.
lead present	0	...	Hot and cold water, gloves furnished.	Concrete floor clean.
lead present	1	...	Cold water	Wood floors clean; meals eaten in room.
lead present	1	...	Cold water	Wood floor clean; meals eaten in room.
lead present	0	...	Hot and cold water, respirators, gloves and goggles	Wood floor dusty; 4 small lead pots no hood; 8 workers use lead.
tests	0	...	Hot and cold water, soap furnished.	1 lead pot, no hood; cement floor clean; meals eaten in room.
lead present	0	...	Hot and cold water, soap furnished.	Wood floor clean.
lead tests	0	...	Hot and cold water	.....
No lead present	0	...	Hot and cold water	Dirt floor clean; men given time to wash up.
No lead present	0	...	Gloves furnished	1 lead pot, no hood; no washing facilities.
No lead present	1	...	.....	No washing or drying room.
No lead present	0	...	Hot and cold water	.....
mg. lead per cu. in. air at metal pot.	2	...	Hot and cold water	Babbitt metal; heating food on metal pot; 1 case in hydrant painter; meals eaten in shop.
No tests, pot idle	0	...	Hot and cold water	Wood floor clean; 1 lead and tin pot; no hood; meals eaten in room.
No lead present	0	...	Hot and cold water	Cement floor clean; meals eaten in room.
No lead present	0	...	Hot and cold water	Cement floor clean; meals eaten in room.
No lead present	0	...	Hot and cold water, gloves furnished.	Wood floor clean; solder furnace not hooded; meals eaten.
No lead present	1	...	.....	.....
No lead present	0	...	Hot and cold water and soap	Wood floor clean.
16 mg. lead per cu. m. air at solder pot.	...	...	Cold water and soap	½ hour given help to wash up.
No lead at end where girls feed machines.	0	...	.....	Wood floor clean.
No tests	1*	...	Gloves furnished	Wood floor clean; meals eaten in room.
No lead present	0	...	.....	Sold put on cold by machine; wood floor clean.
t seam soldering machine pot 1.3 mg. lead per cu. m.	2	..	Cold water and gloves furnished.	Exhaust system temporarily disabled; some hoods being changed; wood floor clean; meals eaten in room.
t end soldering machine pot 2.6 mg. lead per cu. m.				

FACTORIES VISITED WHERE LEA

Index.	Industry.	Employees.		Portion of plant visited.	Material used.	Ventilation.
		Male.	Female.			
20	Tin cans	200	100	Soldering room	Metallic lead, several tons daily.	Machines hooded with exhausts.
21	Tin cans	4	0	Soldering room	Metallic lead, amount not given.	Natural doors and windows.
22	Colors and paints	20	0	Mixing room	Linseed oil, lead carbonate, oxides, chromes, arsenic.	Natural windows.
				Packing room	Arsenic	Natural windows.
23	Paints	2	0	Grinding room	Lead, carbonate, oxides, and chromes, amount not given.	Natural windows.
		11	0	Mixing room	Linseed oil, lead colors.	Natural windows.
24	Paints	9	3	Mixing room	Arsenic greens, lead carbonate, oxides and chrome, 200 tons a year.	Natural windows.
		2	0	Putty room	Lead carbonate and oxide, whiting, linseed oil.	Natural windows.
25	Paints	3	0	Mixing room	Lead carbonate, oxides and chromes.	Natural windows.
26	Paints	3	...	Mixing room	Lead carbonate and oxides, 500 lbs. a week.	Natural windows.
27	Varnish and Enamels	3	0	Mixing room	Lead carbonate and oxides, 200 tons a year.	Natural windows; skylight.
		7	0	Chimney room	Lead carbonate, oxides and chromes, 2 tons a year.	Natural chamber with flues to s for kettles.
		1	0	Enamel mixing room.	Lead carbonate, oxides and chromes.	Natural windows.
28	Oil cloth	4	0	Mixing room	Lead carbonate, oxides and chromes, amount not given.	Natural windows.
		4	0	Varnish room	Litharge	Natural kettles hood ed to vent pipe.
29	Artificial leather	6	0	Mixing room	Castor oil, lead carbonate, chromes, arsenic greens.	Natural windows and skylights.
30	China ware	6	0	Glaze dipping	Lead carbonate	Natural windows.
		4	14	Litho transfer dept.	Lead carbonate and chromes.	Exhaust over dust ing and machines
31	China ware	2	4	Glaze dipping	Lead carbonate	Natural doors and windows.
		2	6	Decorating room	.....	Natural tinting don under hood wit exhaust.
32	Electric insulators	3	0	Lead fusing room	Metallic lead, 5 tons a year.	Natural doors and windows, lead pot under brick hood
33	Glass	7	0	Mixing and weighing room.	Lead carbonate and oxide, 500 tons a year; arsenic, 6 tons a year.	Natural windows and skylights; arches t other rooms.
34	Glass	50	0	Furnace room	Lead carbonate and oxide in furnaces, 50 tons a year; arsenic, 1 ton a year	Natural windows.
35	Cut glass	12	0	Finishing room	Lead putty	Natural windows and skylights.
		1	0	Putty room	Metallic lead	Natural windows an skylights.
36	Cut glass	4	0	Finishing room	.....	Natural windows and skylights.

ARSENIC WAS USED — Continued.

Air analysis.	Cases of Poisoning.		Welfare.	Remarks.
	Lead.	Arsenic		
lead present.....	0	...	.....	Meals eaten in room; wood floor clean.
lead present.....	0	...	Hot and cold water, soap towels and gloves.	Hand soldering furnaces, not hooded; meals eaten; place clean.
lead or arsenic present....	2	0	Hot and cold water.....	Mills and grinders open; wood floor dirty.
lead or arsenic present....	0	0	Hot and cold water.....	No arsenic manufacturing; no provisions for handling dust.
lead present, no dusty process at time of visit and tests	2	0	.....	Wood floor dirty; no provisions to keep down dust; meals eaten in all rooms.
lead present, no dusty process at time of visit and tests	2	0	.....	Wood floor dirty; no provisions to keep down dust; meals eaten in all rooms.
dusty processes at time of visit.	0	0	Hot and cold water, soap and towels.	Rooms partitioned off mixing room for dressing and lunch room.
.....	0	...	.....	Many males and females eat lunch in the mixing rooms.
lead present.....	0	...	Hot and cold water, soap and towels.	Wood floor clean; no dry colors being handled at time of visit.
.....	1	...	Hot and cold water, soap and towels.	Wood floor clean; no dry colors being handled at time of visit.
...sts.....	0	...	Hot and cold water, shower baths, soap and towels; respirators and gloves furnished.	No handling of dry colors at time of visit.
lead present.....	0	...	.....	.....
tests.....	0	...	.....	Mills inclosed.
dry mixing being done, no ead present.	0	...	Hot and cold water.....	New mixer being installed.
lead present.....	0	...	.....	.....
nt traces of lead under microscope.	0	...	Hot and cold water, company physician.	Concrete floor clean; strong odor of amyl.
ces of lead found.....	0	...	Company has a physician, notices are posted.	Floors dampened during day; cleaned once a day.
lead present.....	0	...	Hot and cold water, soap towels and mills furnished	.....
ces of lead found.....	0	...	Hot and cold water, soap, towels and aprons furnished.	Analysis of wash water used by one girl: Floors dampened during day, mopped at night.
lead present.....	0	...	.....	No dust removers on litho transfer work.
tests, no lead being run...	0	...	Sink and cold water.....	No lead used in porcelain glaze; analyzed none found.
ighing 3.3 mg. lead per cu. ietre, no arsenic. ing 2.6 mg. lead per cu. ietre, no arsenic.	2	0	Respirators furnished, emergency hospital.	No provisions to keep down; men do not wear respirators.
lead or arsenic present....	0	0	.....	Place old and poorly lighted; no mixing being done.
lead present.....	6	...	Water, soap and respirators furnished.	Wood floor clean; workers careless; do not use respirators.
lead present.....	0	...	Water, soap and respirators furnished.	Floor clean.
lead present.....	0	...	Soap and water.....	Wood floor clean; only few finishers at work; 1 case reported to department, not there.

FACTORIES VISITED WHERE LE

Index.	Industry.	Employees.		Portion of plant visited.	Material used.	Ventilation.
		Male	Female.			
37	Rubber goods.....	4	0	Weighing room.....	Lead carbonate. oxide, chromate, arsenic colors.....	Natural doors windows.
		1	0	Mixing room.....	Lead carbonate, oxide, chromate, arsenic colors....	Natural doors windows.
		100	25	Cement room.....	Lead sulphide combined in rubber.	Natural doors windows.
38	Rubber tubes and tires.	1	0	Weighing room.....	Lead carbonate and oxides.	Natural doors windows.
		4	0	Mixing room.....	Lead carbonate and oxides.	Natural doors windows.
39	Enamelled letters....	5	15	Main room.....	Metallic lead.....	Natural doors windows.
40	Enamelled letters....	3	0	Main room.....	Metallic lead.....	Natural doors windows.
41	Sulphuric acid.....	...	...	Acid room.....	Lead chambers in use..	Natural doors windows.
42	Jewelry and novelties	8	30	Enamel room.....	Metallic lead and lead colors.	Enamel ovens nected with haust.
		8	30	Setting up room.....	Metallic lead and lead colors.	Natural metal hooded.
43	Cream separators....	15	0	Paint shop.....	Lead putty containing 65% lead.	Plenum system.
		30	0	Soldering room.....	Metallic lead.....	Natural windows skylights.
44	Wheels and carriage bodies.	8	0	Finishing room.....	Lead colors and varnish	Natural doors windows.
	Automobile bodies...	12	0	Finishing room.....	Lead colors and varnish	Natural doors windows.
45	Carriage painting....	4	0	Paint shop.....	Lead colors and varnish	Natural doors windows.
46	Automobile bodies...	6	0	Finishing room.....	Lead colors and varnish	Natural doors windows.
47	Carriages.....	10	0	Finishing room.....	Lead colors and varnish, 500 lbs. a year.....	Natural doors windows.
48	Carriages.....	50	0	Paint shop.....	Lead colors and varnish, 1 ton a year.....	Natural doors windows.
49	Lithographing.....	150	0	Press room.....	Lead colors used.....	Plenum system.
		2	0	Color mixing room...	Lead colors and arsenic greens.	Natural doors dows and skylig
		12	0	Bronzing room.....	Bronzing powder.....	Plenum system; haust system bronze machine
50	Newspaper.....	45	0	Linotype and stereotype room.	Metallic lead in type...	2-24 inch exh fans; pots of l type and stereo machines hood
51	Newspaper.....	6	0	Linotype room.....	Metallic lead in type...	30 inch exhaust linotypes hood and piped.
		4	0	Stereotype room.....	Metallic lead in type...	Natural air s metal pot hoo
52	Storage batteries....	20	0	Casting room.....	Metallic lead, 24 tons a day.	Natural windows skylights.
		17	0	Pasting room.....	Lead oxide compounds.	Exhaust system pasting tables.
		12	0	Assembling.....	Burning off pasted plates.	Natural doors windows.
53	Storage batteries....	50	0	Casting room.....	Metallic lead, 30 tons a day.	Metal pots conn to exhaust.
		28	0	Pasting room.....	Lead oxide compound..	Exhaust system pasting tables.
		2	0	Weighing room.....	Lead oxide.....	All operations nected to exha
		40	0	Burning off room....	Burning off pasted plates.	Exhaust system.

t ARSENIC WAS USED — Continued.

Air analysis.	Cases of Poisoning		Welfare.	Remarks.
	Lead.	Arsenic		
lead or arsenic present....	0	0	Hot and cold water, respirators furnished.	Wood floor clean; no weighing being done; men do not use respirators.
g. lead per cu. metre air, no rsenic.	0	0	Gloves furnished, 8 mg. lead per cu. metre air, no arsenic.	Workers covered with dust, place dusty.
lead present.....	0	...	Hot and cold water.....	Concrete floor clean; odor of naphtha and benzine strong.
tests, no weighing being done.	1	...	Cold water, gloves furnished	Wood floor clean; no hoods over mixers.
lead present.....	0	...	Cold water, gloves furnished	Wood floor clean; meals eaten; no ingredients being added to mixer.
lead present.....	0	...	Cold water.....	Wood floor clean; metal pot not hooded.
lead present.....	0	...	Cold water.....	Wood floor clean; metal pot not hooded.
lead present, no arsenic...	0	0	.....	Acid chamber leaking.
lead present.....	0	...	Hot and cold water, soap...	Wood floor clean; meals eaten in shop.
lead present.....	0	...	Hot and cold water, soap...	Wood floor clean.
tre of room no lead present reathing level of sandpaper 8.8 mg. per cu. m.	4	...	Hot and cold water, soap...	Concrete floor clean; putty applied by hand, baked on, then sandpapered.
lead present.....	0	...	Hot and cold water, soap...	Wood floor clean; no hoods over solder furnaces or machines.
mg. lead per cu. m. at level f sandpaper, no lead in centre of room.	1	...	Cold water.....	Wood floor clean.
lead present.....	0	...	Cold water.....	Concrete floor clean.
lead present.....	2	...	Cold water.....	Wood floor clean; no sandpapering at time of visit; meals eaten.
lead present.....	2	...	Cold water.....	Wood floor clean; no sandpapering at time of visit; meals eaten.
lead present.....	0	...	Hot and cold water.....	Wood floor clean; no lead filler used wet pumice and rubbing done; meals eaten in room.
lead present.....	2	...	Hot and cold water.....	Wood floor clean; meals eaten in shop.
lead present.....	0	...	Hot and cold water, soap and towels furnished.	Cleaning off of litho stones done in one portion of room.
lead or arsenic present....	1	0	.....	Mixers open; pony mixer enclosed; no provisions for handling dust.
lead or arsenic present....	0	0	Vacuum cleaner for floors and benches.	Analyses of bronze powder showed no lead or arsenic present.
lead present.....	0	...	Cold water, soap and towels	Wood floor clean; Stereotype room is a portion of the composing (linotype) room.
lead present.....	0	...	Cold water soap and towels	Wood floor clean.
lead present.....	0	...	Cold water.....	Wood floor; dross scattered about.
mg. lead per cu. m. of air.	3	...	Hot and cold water, soap, towels and gloves furnished, also pills if asked for.	Gloves in poor shape; no hoods over metal pots.
mg. lead per cu. m. of air.	7	...	.....	Place dirty; men careless.
mg. lead per cu. m. of air t lead burner.	4	...	.....	Wood floor clean; tables dampened during day.
mg. lead per cu. m. of air t pots.	1	...	Hot and cold water, soap and soap powder, towels, gloves and respirators furnished.	Material on floor; litharge found in water cooler; workers unclean.
mg. lead per cu. m. of air.	17	...	.....	.....
lead present.....	0	...	.....	.....
mg. lead per cu. m. of air t burners' table.	2	...	.....	1 case of lead poisoning was from assembling room.

FACTORIES VISITED WHERE LE

Index.	Industry.	Employees.		Portion of plant visited.	Material used.	Ventilation.
		Male.	Female.			
54	Electrical equipment.	110	0	Brass foundry.....	Metallic lead, amount not given.	Natural crucibles der hood.
		45	0	Cable department...	Metallic lead, amount not given.	Natural windows, Texas roof. louv
		5	0	Rubber insulating, weighing room.	Lead oxides, amount not given.	2-30 inch exhaustf in window.
		40	0	Rubber insulating, mixing room.	Lead oxides compound, amount not given.	Natural windows doors.
		10	60	Soldering room.....	Metallic lead, amount not given.	Solder furnace hoo to exhaust.
55	Electrical equipments	17	...	Brass foundry.....	Metallic lead.....	Natural Texas r louvres.
		8	...	Cable department....	Metallic lead.....	Natural.
56	Electrical cables.....	6	...	Lead cable room....	Metallic lead.....	Natural meta[3] hooded and
		2	...	Rubber cable, weighing room.	Lead oxide.....	Natural windo[s] skylights.
		6	...	Rubber cable, mixing room.	Lead oxide compounds.	Natural windo[s] skylights.
57	Motor vehicles.....	18	0	Foundry.....	Metallic lead.....	Natural windo[s] Texas roof, l[h]

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Medical Inspector of Fa

: ARSENIC WAS USED — Continued.

Air analysis.	Cases of Poisoning.		Welfare.	Remarks.
	Lead.	Arsenic		
.....	0	...	Hot and cold water, soap...	Concrete floor and dirt; meals eaten in room.
lead present.....	0	...	Hot and cold water.....	Metal pots not hooded.
ıg. lead per cu. metre air...	2	...	Hot and cold water and respirators.	Men do not wear respirators furnished.
mg. lead per cu. metre at nasticators.	5	...	Hot and cold water and respirators.	Men do not wear respirators furnished; meals eaten in room.
lead present.....	0	...	Hot and cold water.....	Wood floor clean.
.....	0	...	Water.....	Men not clean; meals eaten in room.
.....	0	...	Hot and cold water, gloves furnished.	Wood floor not clean; men do not wear gloves and are not clean.
lead present.....	0	...	Water.....	Meals eaten in the factory and the men are not clean.
mg. per cu. m. air.....	1	...	Water.....	
mg. per cu. m. air at mixers	2	...	Water.....	
ıces of lead present.....	0	...	.....	Flow brick and dirt; men careless.

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RESULTS OF SPECIAL ANALYSES.

SPECIMEN ANALYZED.	Sex of operator.	Occupation.	Length of time specimen was in use or operative had been at the occupation.	Grams of lead found.	Percentage of lead.
Pair of gloves	Male	Lead pipe worker	Gloves in use 1 day	.6100	
Pair of gloves	Male	Lead pipe worker	Gloves in use 3 days	1.3700	
Piece of clothing	Male	Pigment mixer, rubber works	Clothes in use 3 months in factory.	.1250	
Respirator sponge	Male	Mixer, lead glass works	In use 2 or 3 months	.3760	
Filler and dye for tan shoes	Male	Removing defects, shoe factory			12% chromate.
Filler and dye for tan shoes	Male	Removing defects, shoe factory			14% chromate.
Water, hands were washed in	Female	Assistant to glaze dipper, pottery	Hands washed after 4½ hours morning work	.0040	
Water, hands were washed in	Male	Compositor, job or hand	Hands washed after 4 hours morning work	.0003	
Water, hands were washed in	Male	Color mixer, lithographing works	After 5 hours morning work wiped on cloth, then washed	.0874	
Accumulation under finger nails	Male	Solderer, metal ware	Worked 4 years as solderer; never cleaned nails thoroughly	.0023	
Urine analysis	Male	Burner off, storage batteries	Worked 2 years at burning off plates No symptoms		No lead found.
Urine analysis	Male	Paster, storage batteries	Worked 1 year at pasting plates. No symptoms		Traces of lead.
Urine analysis	Male	Carriage painter	Worked 3 years at painting. No symptoms		Traces of lead.
Floor sweepings		Newspaper, linotype room	Floor cleaned daily. Sample at linotype late at night	17.4000	
Floor sweepings		Glaze mixing, pottery	Floor cleaned daily. Sample taken at end of work day	10.6100	
Floor sweepings		Soldering room, can factory	Floor cleaned daily. Sample from under machine at end of day	30.7600	
Rubber after leaving masticator		Secured from mixing machine			25% lead.
Rubber after vulcanizing		Taken from lot leaving vulcanizer			24+ % lead.

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In compiling the following bibliography an endeavor has been made to afford a ready reference to specific articles relating to the subjects investigated. The material is as nearly up to the present date as it was possible to ascertain.

There have no doubt been a number of articles overlooked, and to have enumerated all the references in works on medicine and hygiene would have been an enormous task, so they were omitted.

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